Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	**2. REPORT TYPE**	**3. DATES COVERED**
18-06-10	Master's Thesis	27-07-09 to 18-06-10

4. TITLE AND SUBTITLE
"Combat Fitness a Concept Vital to National Defense"

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR (S)
Major Christopher P. Larkin, U.S. Air Force

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME (S) AND ADDRESS (ES)
National Defense University, Joint Forces Staff College, 7800 Hampton Blvd, Norfolk, VA, 23511-1702

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME (S) AND ADDRESS (ES)

10. SPONSOR/MONITOR'S ACRONYM (S)

11. SPONSOR/MONITOR'S REPORT NUMBER (S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT Current combat operations have uncovered some disturbing issues in the ground combatant's mental and physical ability to withstand the extreme demands of continuous combat operations in the harsh environmental conditions, such as those seen in Iraq and Afghanistan. These issues are creating significant problems in the American military's ability to sustain a healthy force able to handle the country's most difficult tasks. This research paper takes a critical look at the Service level physical fitness programs to determine if the fitness training currently being conducted is sufficient to train and sustain the ground combatants throughout their military careers. In today's environment of a tightening budget, reduced manpower and rising healthcare costs, it is imperative that the DoD take the appropriate actions to prepare and maintain its most vital weapons system, the human. Therefore, the DoD must embrace and incorporate modern physical fitness training systems, techniques, technology, and testing to better train and prepare ground combatants for the rigors of combat, including improved battlefield effectiveness and prolonged individual operational longevity, while minimizing the rash of short- and long-term injuries currently plaguing the force.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			**19b. TELEPHONE NUMBER** *(including area code)*
Unclassified	Unclassified	Unclassified	Unclassified Unlimited		757-515-9879

THIS PAGE INTENTIONALLY LEFT BLANK

JOINT FORCES STAFF COLLEGE
JOINT ADVANCED WARFIGHTING SCHOOL

COMBAT FITNESS A CONCEPT VITAL TO NATIONAL SECURITY

by

Christopher P. Larkin

Major, U.S. Air Force

A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning and Strategy. The contents of this paper reflect my own personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense.

This paper is entirely my own work except as documented in footnotes.

Signature: _____

18 June 2010

Thesis Advisor: Dr. Paul Melshen, JFSC

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

Current combat operations have uncovered some disturbing issues in the ground combatant's mental and physical ability to withstand the extreme demands of continuous combat operations in the harsh environmental conditions, such as those seen in Iraq and Afghanistan. These issues are creating significant problems in the American military's ability to sustain a healthy force able to handle the country's most difficult tasks. This research paper takes a critical look at the Service level physical fitness programs to determine if the fitness training currently being conducted is sufficient to train and sustain the ground combatants throughout their military careers. In today's environment of a tightening budget, reduced manpower and rising healthcare costs, it is imperative that the DoD take the appropriate actions to prepare and maintain its most vital weapons system, the human. Therefore, the DoD must embrace and incorporate modern physical fitness training systems, techniques, technology, and testing to better train and prepare ground combatants for the rigors of combat, including improved battlefield effectiveness and prolonged individual operational longevity, while minimizing the rash of short- and long-term injuries currently plaguing the force.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to all those that supported my efforts in completing this thesis. I would like to thank my thesis advisor Dr. Paul Melshen for his confidence and encouragement.

First I would like to thank the library staff for their undying support, encouragement and incredible ability to get a copy of every article and book that I "needed" to support my paper. Specifically, Dr. Gail Nicula provided incredible support with nearly every aspect of this effort.

Next, I would like to thank the men who were the genesis of this idea, Mr. Bill Lyons, Mr. Vint Anderson and Dr. Michael Zupan. These fine gentlemen have been refining the Air Force Special Tactics "Combat Athlete" concept for the last 4 years. Without them I would not have been able to articulate many of thoughts and concepts presented.

Finally, words alone cannot express my thanks to my wife, Stephanie, and our three children Lexi, Luke and Madeline for their love and encouragement during this "break" at school. I know long days and working weekends were not supposed to be part of this deal and you never said a word and were always there for me, every day you helped to remind me how lucky I am to have you in my life. Without your support and understanding completing this endeavor would not have been possible.

TABLE OF CONTENTS

TABLES

INTRODUCTION

Problem Statement

Current combat operations have uncovered some disturbing issues in the ground combatant's mental and physical ability to withstand the extreme demands of continuous combat operations in the harsh environmental conditions, such as those seen in Iraq and Afghanistan. These are not new discoveries, as mental and physical limitations have long been a concern of senior military commanders; however, numerous societal conditions and beliefs have developed and/or matured in America that are making these conditions worse than previously seen. These are creating significant issues in the American military's ability to sustain a healthy force able to handle the country's most difficult jobs.

Foundationally, this problem begins with the emerging health and fitness problems seen in the youth of America. Unfortunately, the health of the "fast food or Nintendo generation," has been in a steady decline over the past four or five decades. In fact, "only 25 % of students in grades 9 through 12 engaged in moderate physical activity for at least 30 minutes on 5 or more of the previous 7 days in 2003. Further, only 28 % of students in grades 9 through 12 participated in daily school physical education in 2003, down from 42 % in 1991."[1] Add to this the fact that "17.8 % of children and teens aged 12-17 were overweight in 2005 - 2006, more than triple the proportion from 1976 - 1980.

[1] U.S. Department of Health and Human Services, "Physical Activity Facts," The President's Council on Physical Fitness and Sports, http://www.fitness.gov/resources_factsheet.htm (accessed August 2009).

Fifteen-percent of children in the same age group are considered at-risk to become overweight. The percentage of overweight African American, Hispanic, and native American children is about 20%."[2] The result is an emerging population that exercises less and is becoming more obese. These facts are just two of the societal conditions that directly affect the recruiting and training of our military. This is critical, as the military must train every new recruit to a physical and mental standard that will enable him or her to be successful on the battlefield. If the entrants are not physically capable, the standard fitness-training plan must be altered to accommodate these less physically capable trainees. These identified trends potentially threaten our national security and present significant challenges that must be addressed in the fitness programs for each Service.

Besides the declining physical fitness status of our youth, the American public has become much more risk averse. The rise of technology, 24-hour news coverage, and to some degree, the shrinking all volunteer military force can be attributed to this risk aversion. For the ground combatant, this has translated into an increased "soldier's load." Risk aversion and technology have combined to help mature body armor; however, with the increased protection that the American public demands comes the price of additional weight that the ground combatant must deal with on the battlefield. Current conditions often require combatants to carry loads that range anywhere from 63 to more than 130

---

[2] U.S. National Center for Chronic Disease Prevention and Health Promotion, *Preventing Obesity and Chronic Diseases through Good Nutrition and Physical Activity*, (Atlanta, GA: Centers For Disease Control & Prevention, National Center for Chronic Disease Prevention and Health Promotion, U.S. Department of Health and Human Services, 2005), 1.

pounds of equipment, depending on the mission type, duration and environment.[3] Numerous studies show that carrying this type of load under these conditions causes pain, reduces performance, increases fatigue and, ultimately, causes injuries. Despite several organizational specific programs, the Service-wide fitness programs are outdated and do not support the functional demands of the missions and the soldier's load in today's combat environment. In fact, the Army alone has some 20,000 soldiers who are considered non-deployable based upon load-bearing injuries sustained while deployed.[4] Clearly, societal changes have driven the military to carry more gear than is physically reasonable, and in many cases, combatants are suffering the after effects of these decisions. What have yet to be seen are the long-term medical issues and subsequent costs that will haunt the military for years to come if appropriate physical fitness training processes are not implemented across the Department of Defense (DoD).

Current fitness training and testing programs across the DoD are seriously lacking in many ways. In broad terms, the Service training methodologies are outdated and are directed at the masses for ease of application and not for maximum performance improvement. Further, as a whole, the programs are not designed to deal with the less fit trainees in order to mitigate the differences in initial capabilities. Unfortunately, the long-term effects that may be occurring in individuals who are subjected to "old school" physical fitness programs are not fully understood. For example, Army basic training is

---

[3] General Peter W. Chiarelli, Vice Chief Of Staff United States Army, Speaking On Soldier Equipment Ergonomics, on March 11, 2009, to the House Appropriations Committee Subcommittee on Defense, 111th Congress, 1st Session, 5.

[4] Ibid.

experiencing 25% injury rate for men and 50% injury rate for women.[5] One can expect that some of these injuries will be of a long-term nature, and may even follow the individuals through their careers and into retirement. Injuries to the articulating surface of joints will never heal and cannot be rehabilitated to their original state. Most other musculoskeletal injuries leave scar tissue, which limits the range of motion, and ultimately, will reduce the operational longevity and overall physical ability of the ground combatant. Worse yet is the fact that there are virtually no efforts underway to develop skills and fitness that will better enable the ground combatant to handle the stress of the environment and the growing soldier's load while mitigating injuries. Clearly, changes are needed in both the fitness programs and the thought processes behind their development.

In today's environment of a tightening budget, reduced manpower and rising healthcare costs, it is imperative that the DoD take the appropriate actions to prepare and maintain its most vital weapons system, the human. With literally hundreds of billions of dollars being spent on research and development for planes, tanks and ships, a focused and synchronized effort across the Services for development of the human weapon system is required in order to preserve this nation's most vital asset. Special Operations Forces "Truths" offer wisdom in the form of guidelines that could prove extremely relevant to this point:

---

[5] Joseph J. Knapik, and others, *Injury Incidence and Injury Risk Factors Among U.S. Army Basic Trainees at Ft. Jackson SC, 1998 (Including Fitness Training Unit Personnel, Discharges, and Newstarts)* (Ft. Belvoir: Defense Technical Information Center, 1999), 5.

1. Humans are more important than Hardware.
2. Quality is better than Quantity.
3. Special Operations Forces cannot be mass produced.
4. Competent Special Operations Forces cannot be created after emergencies occur.[6]

Quality over quantity applies in many ways, from the individual ground combatant right down to the physical exercises conducted every time a warrior is training. The DoD cannot turn back time, it can only hope to mitigate the damages from the current situation and build the combat athlete for tomorrow's fight. This ground combatant should be one who excels on the battlefield, is able to sustain that capability throughout his or her career, and retire healthier than his or her predecessors. Therefore, considering the current state of affairs, it has never been more important to take smart and deliberate actions to modify, update and, where necessary, completely rewrite the Service's current physical fitness programs.

Effective leadership is critical to make sweeping changes in the military, and even more so, if one is to inculcate new policies, directives and beliefs that ultimately create the culture required for changes to take effect. This problem is difficult, as it will need to be directed to the Services, and into the individual branches and elements within those Services. This paper addresses the ground combatant element from each Service. Quality leadership up and down the chain within each Service is vital to make the required changes to preserve the force today, and to take it into the future. With appropriate guidance, willing and able leaders will need to create a fitness culture much

---

[6] U.S. Army Special Operations Command, "SOF Truths," HQ USASOC Special Operations Forces Information, http://www.soc.mil/sofinfo/truths.html (accessed October 2009).

like the Marines in order to develop and maintain a healthy and more effective combat force that will be able to handle the nation's most difficult tasks.

This paper asserts that the DoD must embrace and incorporate modern physical fitness Tactics, Techniques, and Procedures (TTP) to improve the ground combatant's battlefield effectiveness and prolong individual operational longevity.

Scope of the study

This study illustrates that the current Service physical fitness programs are not sufficient to prepare and maintain the ground combatant's long-term health and battlefield effectiveness. In pursuit of this end, a thorough review of current literature in this field was necessary in order to obtain a better understanding of the range and severity of the musculoskeletal injuries and injury rates caused by environmental and equipment operational demands of the current combat deployments. This review also addresses the current Service-wide physical fitness programs and the development of new programs being looked at to improve combat fitness. An extensive oral interview schedule of both military and industry fitness experts provides examples of new military combat fitness training programs that are working and providing excellent results. The literature review revealed that the industry is replete with too many training solutions to review and evaluate all of them. Therefore, this study focuses solely on those combat-oriented programs that have potential to address some of the issues currently being experienced. The civilian fitness programs studied were ones that incorporated modern training systems, techniques, technology, and testing, that might better prepare and preserve the ground combatant. All of this research combined aims to provide a thorough depiction of

the current state and the issues. Further, recommendations have been developed that, should the Services adopt them, will increase combat effectiveness, minimize injuries and prolong the operational longevity of a ground combatant.

Limitations

As previously stated, this research paper focuses on the ground combatant and not the entire DoD. Ground combatants are considered individuals who regularly operate outside the wire of the base while in a combat zone. The obvious ground combatants include the Army infantry soldier, the Marine Corps, and the special operations ground forces from each Service. Additionally, they include the numerous non-standard career fields that currently fulfill ground combatant roles. Typically, these are men and women who have not spent their careers preparing for the harsh environment, the "soldier's load," or the combat zone. A few examples include the convoy drivers, members of a Provincial Reconstruction Team, and medics that may have to transport patients in the combat zone. Each of these combat roles is being filled with a wide variety of military personnel, many who have not regularly trained for the combat environment. With this understanding, the majority of the recommendations highlighted in this paper are applicable to the entire force and would be beneficial to all military personnel, but are primarily aimed at the ground combatant.

Chapter Summary

This research paper takes a critical look at the Service level physical fitness programs across the DoD to determine if the fitness training currently being conducted is sufficient to train and sustain the ground combatants throughout their military careers.

The DoD must embrace and incorporate modern physical fitness training systems, techniques, technology, and testing to better train and prepare ground combatants for the rigors of combat, including improved battlefield effectiveness and prolonged individual operational longevity, while minimizing the rash of short- and long-term injuries currently plaguing the force. The following chapter will discuss general physical fitness components, concepts and definitions in order to provide a sense of where the military is today and what needs to be added or changed in order to begin combat fitness training.

CHAPTER I

Physical Fitness 101

Chapter Overview

Before breaking down the status of each military Service's physical fitness program, it is important to have a common understanding of the terminology and concepts that will be central to this discussion. This chapter starts by briefly describing the core concepts of military fitness, breaking out key terms, and providing common definitions. These terms will be essential to understanding fully the current programs and the recommended improvements in order to increase the ground combatant's effectiveness on the battlefield and extend his or her operational longevity. Finally, this chapter will close with a detailed description of combat fitness and how it applies to the modern ground combatant.

Fitness Basics

Unfortunately, there are few concise and agreed upon definitions of physical fitness. The President's Council on Physical Fitness and Sports uses the U.S. Department of Health and Human Services definition of fitness: "A set of attributes that people have or achieve relating to their ability to perform physical activity."[1] Another equally nebulous, but often used, definition for physical fitness is: "A state of well-being with

[1] U.S. Department of Health and Human Services, "Physical Activity Facts," The President's Council on Physical Fitness and Sports, http://www.fitness.gov/resources_factsheet.htm (accessed August 2009).

low risk of premature health problems and energy to participate in a variety of physical activities."[2] In order to establish a solid foundation for this paper and for the discussion and recommendations, it is critical to identify a definition that is clear, concise and complete. For the purpose of this paper, the standard definition for physical fitness found at Answers.com will establish the basis for the discussion in this chapter.

> If you are physically fit, you are free from illness, and able to function efficiently and effectively, to enjoy leisure, and to cope with emergencies. Health-related components of physical fitness include body composition, cardiovascular fitness, flexibility, muscular endurance, and muscle strength. Skill-related components include agility, balance, coordination, power, reaction time, and speed.[3]

The comprehensive nature of this definition was the sole reason behind its use. The focus for each Service is primarily a health-based approach. In the next chapter, each Service program will be discussed in depth to identify the differences and similarities. For the purposes of this chapter, the five health-related and six skill-related components will define the core elements of physical fitness. In the context of combat fitness, these components are relevant; however, there are expanded skills, components, principles and more in-depth definitions that are critical in understanding how to increase the ground combatant's effectiveness and improve the individual's operational longevity.

---

[2] Ibid.

[3] Answer.com, "Physical Fitness," Reference Answers, http://www.answers.com/topic/physical-fitness (accessed October 2009).

Principles of Fitness

In addition to the components of fitness, it is important to have a solid understanding of the generally accepted principles of exercise. According to Army Field Manual 21-20, "adherence to certain basic exercise principles is important for developing an effective program. The principles of exercise apply to everyone at all levels of physical training, from the Olympic-caliber athlete to the weekend jogger. They also apply to fitness training for military personnel."[4] These principles are listed below:

> Regularity - To achieve a training effect, a person must exercise often. One should strive to exercise each of the first four fitness components at least three times a week. Infrequent exercise can do more harm than good. Regularity is also important in resting, sleeping, and following a good diet.
>
> Progression - The intensity (how hard) and/or duration (how long) of exercise must gradually increase to improve the level of fitness.
>
> Balance - To be effective, a program should include activities that address all the fitness components, since overemphasizing any one of them may hurt the others.
>
> Variety - Providing a variety of activities reduces boredom and increases motivation and progress.
>
> Specificity - Training must be geared toward specific goals. For example, soldiers become better runners if their training emphasizes running. Although swimming is great exercise, it does not improve a 2-mile-run time as much as a running program.
>
> Recovery - A hard day of training for a given component of fitness should be followed by an easier training day or rest day for that component and/or muscle group(s) to allow muscle repair and recovery. Another way to allow recovery is to alternate the muscle groups exercised every other day, especially when training for strength or power.

---

[4] U.S. Army. "Physical Fitness Training." *Field Manual 21-20.* (HQ, Department of the Army, Washington, D.C., 1998), 1-4.

Overload - The workload of each exercise session must exceed the normal demands placed on the body in order to bring about a training effect.[5]

Combat Fitness Defined

This paper argues that there is a need to conduct physical fitness in a manner that better prepares the ground combatant for the extreme nature of war and all that it requires. Additionally, this training should be oriented to increase the longevity of the ground combatant. The type of physical training required to achieve these goals, or combat fitness, should be functionally oriented to the tasks required when in combat. Physical fitness testing has traditionally been focused on a 1.5- to 3-mile run, push-ups, sit-ups, and, in some Services pull-ups, flexibility, and waist measurement. These events may provide a basic health and wellness fitness assessment, but they do not fully consider that the current ground combatant is required to carry anywhere from 60 to 130 pounds of gear in extreme temperatures, both hot and cold, at extreme elevations, and often under direct fire. The individual is required to move, shoot, communicate and think in these austere and demanding conditions. Clearly, the ability to run three miles and do a certain number of push-ups and sit-ups does not prepare the ground combatant adequately for the tasks, the load, or the environment, and when combined it becomes evident that the current philosophy is not a good measure of combat fitness. Thus, the need for a fitness program that develops and sustains functionally focused combat skills and components is readily apparent and necessary.

---

[5] Ibid., 1-4.

In order to develop fully the combat fitness concept, the skills and components must be identified and broken down into trainable movements. The first step is to identify every Mission Essential Task (MET) that the ground combatant is required to perform. These tasks must be broken down into the movements, fitness skills and components required to execute the task. To train effectively and test these elements, standards of performance must be scientifically developed and linked back to the required tasks. Once fully developed, these ground combatant specific METs and the associated elements should be used to design a combat focused fitness program. In the absence of Service-wide, scientific data to determine a standardized cross-Service list of METs, it is reasonable to utilize the Army Warrior Tasks and Battle Drills (WTBDs) to establish a baseline for the functional fitness training requirements. Table 1 on the next page is a breakdown of the warrior tasks and battle drills, and the physical requirements related to those tasks and drills.

Table 1: Warrior Tasks and Battle Drills, Physical Requirements for Performance[6]

Shoot	Physical Requirements
Employ hand grenades	Run under load, jump, bound, high/low crawl, climb, push, pull, squat, lunge, roll, stop, start, change direction, get up/down and throw.
Move	Physical Requirements
Perform individual movement techniques	March/run under load, jump, bound, high/low crawl, climb, push, pull, squat, lunge, roll, stop, start, change direction and get up/down.
Navigate from one point to another	March/run under load, jump, bound, high/low crawl, climb, push, pull, squat, lunge, roll, stop, start, change direction and get up/down
Move under fire	Run fast under load, jump, bound, crawl, push, pull, squat, roll, stop, start, change direction and get up/down.
Survive	Physical Requirements
Perform combatives	React to man-to-man contact: push, pull, run, roll, throw, land, manipulate body weight, squat, lunge, rotate, bend, block, strike, kick, stop, start, change direction and get up/down.
Adapt	Physical Requirements
Assess and Respond to Threats (Escalation of Force)	React to man-to-man contact: push, pull, run, roll, throw, land, manipulate body weight, squat, lunge, rotate, bend, block, strike, kick, stop, start, change direction and get up/down. Run under load, jump, bound, high/low crawl, climb, push, pull, squat, lunge, roll, stop, start, change direction, get up/down and throw.
Battle drills	Physical Requirements
React to Contact	Run fast under load, jump, bound, crawl, push, pull, squat, roll, stop, start, change direction and get up/down.
Evacuate a Casualty	Squat, lunge, flex/extend/rotate trunk, walk/run, lift and carry.

6 U.S. Army Training and Doctrine Command, "Army Physical Readiness Training," *Training Circular 3-22.20*, (Fort Monroe, VA, March 1, 2010), 1-4.

The Army uses these tasks and physical requirements to drive their new physical training concept called Physical Readiness Training (PRT). Soldiers need to be proficient in the WTBDs required to perform their missions at home and while deployed. This list is provided as an interim solution to get the fitness training for the ground combatant underway. Ultimately, the DoD must conduct Joint research to develop a cross-service task list connected to the individual service ground combatant METs. Once the common METs and associated tasks are identified, they can be used to develop a new training concept. This new concept will enable the DoD to realize the full potential of combat fitness training.

When conducting combat fitness training, an additional principle of fitness is required. Precision is a principle that is critical to many of the concepts presented later in this paper. Draft fitness guidance from the Army provides an excellent definition:

> Precision is the strict adherence to optimal execution standards for PRT activities. Precision is based on the premise that the quality of the movement or form is just as important as the weight lifted, repetitions performed or speed of running. It is important not only for improving physical skills and abilities, but to decrease the likelihood of injury due to the development of faulty movement patterns. Adhering to precise execution standards in the conduct of all PRT activities ensures the development of body management and fundamental movement skills.[7]

Clearly, this is a concept that is very different from the previously discussed principles and it is understandable how this could be beneficial to the combat fitness concept. Therefore, the definition of combat fitness must include all the elements of the initial

---

7 Ibid., 2-3.

definition of physical fitness and the addition of the common METs and the associated tasks.

Chapter Summary

In summary, a general definition of physical fitness and all of the components and principles associated was provided. This information made possible an understanding of the generally accepted concepts of physical fitness. These terms will be used throughout this paper and will play an integral role in the development of the thesis. Next, a thorough development of the term "combat fitness" was presented and the concept was supported with information that showed why it is essential to the modern warfighter. As it is a broad ranging term, combat fitness required additional key terms, concepts and components to be introduced and defined.

CHAPTER II

Current Service Fitness Programs

Chapter Overview

Now that clear definitions relating to physical and combat fitness have been presented, it is appropriate to look into how the DoD and the individual Services train and maintain physical fitness. This chapter provides a brief description of physical fitness policy and guidance to highlight what each Service is currently executing. The first section will open with the DoD and then move into each individual Service. The definitions from the previous chapter will be used to identify strengths and weaknesses in each Service program. Where relevant, recent Service program changes or updates will be identified in an attempt to highlight where some physical fitness training specific progress is being made. The chapter will close with a summary status of the programs in total in an effort to establish a baseline to make improvement recommendations.

Review of Current Service Fitness programs

Before wading into the individual Service fitness regulatory guidance, a review of the DoD policy is important to understand fully what is driving the Services. Department of Defense Instruction 1308.1, DoD Physical Fitness and Body Fat Program (June 30, 2004), Department of Defense Instruction 1308.3, DoD Physical Fitness and Body Fat Programs Procedures (November 5, 2002), and Department of Defense Directive 1010.10, Defense Health Promotion (August 22, 2003), are the three primary documents that drive the military physical fitness policy. These documents provide a solid

foundation for the current programs and direct the implementation of a combat fitness-like program that will increase combat effectiveness and extend operational longevity.

Individual requirements are identified in DODI 1308.3: "Service members shall maintain physical readiness through appropriate nutrition, health, and fitness habits. Aerobic capacity, muscular strength, muscular endurance, and desirable body fat composition, form the basis for the DoD Physical Fitness and Body Fat Programs."[1] Clearly, the intent is for the Services to focus on four of the five components: aerobic capacity; muscular strength; muscular endurance; and body composition. This is understandable considering that these are the "health" related components and not the "skill" related components. General health of the force is very important and needs to be addressed; however, combat fitness is aimed at increasing the ground combatants' combat effectiveness and longevity through optimized training plans that focus on all of the identified general fitness components. From this perspective, a more in-depth review is required.

While not specifically identifying combat fitness in the DoD guidance, it provides the Services a wide path to establish and test fitness based on combat requirements. DoD directs fitness training and related physical activities that enhance fitness and general health, but must also look at injury prevention to promote combat readiness.[2] This statement supports the need for a combat fitness program designed to extend operator

---

[1] Department of Defense, "DoD Physical Fitness and Body Fat Program," *DoD Directive 1308.1* (Washington: Government Publishing Office, June 2004), 2.

[2] Department of Defense, "DoD Physical Fitness and Body Fat Programs Procedures," *DoD Instruction 1308.3* (Washington: Government Publishing Office, November 2002), 5.

longevity. Additionally, it says that the Services should incorporate job specific fitness requirements for those career fields where it is deemed necessary to ensure adequate skill, performance, and safety.[3] Therefore, the ground combatant specific METs should be used to design a combat focused fitness program. Once the task list has been developed, each task must be broken down into the required movements and then, in order to take it to the next level, standards of performance must be scientifically derived and linked back to the required task. The guidance clearly states this in DODI 1308.3: "Once the levels or desired physical capability are identified, physical fitness training and testing should be linked to these capabilities."[4] Therefore, because the guidance includes many of the combat fitness concepts, it is clear that guidance provides the Services the leeway to protect and develop their most valued weapons systems, the human. With a better understanding of the overarching physical fitness guidance provided to the Services by the DoD, it is now time to review each Service.

Air Force

The Air Force fitness program is governed by Air Force Instruction 10-248, *Fitness Program*, (25 September 2006, Incorporating Change 1, 22 August 2007). The program is commander-driven and promotes aerobic and muscular fitness, flexibility, and optimal body composition of each airman. Annual testing is based on aerobic fitness, muscular endurance, and body composition to determine overall fitness. The test consists

[3] Ibid.

[4] Ibid.

of a 1.5-mile run, push-ups, sit-ups and a waist measurement. The Air Force is the only Service that uses waist measurement as part of its annual testing. The Air Force believes that the test score is directly related to the individual's health risk. Individuals must score a minimum of 75 out of a 100 to be considered healthy. "Health and readiness benefits continue to increase as body composition improves and physical activity and fitness levels increase. Members are encouraged to optimize their readiness status/posture by improving their overall fitness."[5] The health and wellness efforts are apparent and the benefits are obvious. A healthy work force is essential to an effective operational capability, key in today's increased operational tempo environment. It is also very important in reducing healthcare costs in the constrained budgetary environment in which the DoD must operate. This reason may actually be the biggest driver behind a more complete health and wellness effort.

Late in 2009, the Air Force retooled its fitness program in an effort to promote year-round fitness levels and to ensure quality control during standardized testing that is based on scientific standards. The Air Force Fitness Program website posted the following statement about the purpose of the new program: "The Air Force Fitness Program goal is to motivate Airmen to participate in a year-round physical conditioning program that emphasizes total fitness, to include proper aerobic conditioning, strength and flexibility training, and healthy eating. Health benefits from an active lifestyle will increase productivity, optimize health, and decrease absenteeism while maintaining a

[5] Department of the Air Force, "Air Force Fitness Program," *AFI 10-248* (Washington: HQ USAF/SGO, July 2006) 20.

higher level of readiness."[6] This new program, activated January 1, 2010, directs individual fitness testing twice per year using the current standards until July 1, 2010, when the new standards will be utilized. One of the main changes to the program is that base level certified fitness professionals t will now conduct all annual assessments, as opposed to unit-level physical training monitors. Obviously, the Air Force fitness program's focus is on general health; unfortunately, it is not connected to increased physical performance, extended longevity, or combat fitness.

Army

Army Regulation 350-1, Army Training and Leader Development, (18 December 2009) provides the overarching physical fitness training guidance. This regulation states that the primary objective of Army physical fitness training is to enhance combat readiness and leadership effectiveness by developing and sustaining a high level of physical fitness in soldiers as measured by:

1. Muscular Strength and Endurance.
2. Aerobic and Anaerobic Conditioning/Endurance.
3. Mobility (agility, balance, coordination, flexibility, posture, power, speed and stability).
4. Body Composition standards as prescribed by AR 600–9.
5. Healthy Lifestyle (provides nutrition, avoid smoking and substance abuse, manage stress).
6. Warrior Ethos - mission first, never accept defeat, never quit, and never leave a fallen comrade.
7. Self-discipline, competitive spirit, the will to win, and unit cohesion.[7]

---

[6] U.S. Air Force, "Air Force Fitness Program," Air Force Personnel Center, http://www.afpc.randolph.af.mil/affitnessprogram/index.asp (accessed October 2009).

[7] U.S. Army, "Army Training and Leader Development," *Army Regulation 350-1*, (HQ, Department of the Army, Washington, D.C., 9 April 2003), 11.

The context and the relatively recent publication of this regulation shows signs that the Army program is maturing consistently with senior leader views. Army Vice Chief Staff, General Peter Chiarelli, testified to Congress Mar 11, 2009, that the Amy is working hard to find better ways to train soldiers smarter.[8] Besides Army Regulation 350-1, there is Field Manual 21-20, Physical Fitness Training (1998). Despite being 22 years old, it is the most comprehensive Service document, covering the full gamut of fitness topics from leadership responsibility to environmental considerations.

The Army requires commander-led physical fitness training three to five times per week. There have been a variety of efforts to focus or scope the training the commander should provide, however, it seems that commanders often revert back to what they have been exposed to in their training. Additionally, there seems to be an unusual emphasis on the unit performing well during the semi-annual physical fitness test. The Army physical fitness test was designed to get an accurate evaluation of a soldier's fitness level. All Army personnel must accomplish the test twice each year. The evaluation involves a weigh-in, push-ups, sit-ups and a two-mile run.

The Army has been in the process of redesigning their physical fitness program since early 2000. There have been several draft manuals designed to replace the FM 21-20. On March 1, 2010, the Army released its new fitness manual, Training Circular 3-22.20, Army Physical Readiness Training. This new manual considerably changes the

[8] Chiarelli, 5.

focus and direction from FM 21-20. This document is very complete and shares many of combat fitness concepts and thoughts discussed later in this paper. In fact, many of the changes are supported by studies conducted with basic trainees showing the beneficial nature in regards to performance and injury reduction. Implementation will be a challenge especially since the Army has eliminated the Master Fitness Trainer course and there will be a lack of expertise at the unit level to execute the required tasks and exercises. The information in this publication and the supporting research, highlight that the Army understands that there is a problem. It is not clear how or when this program will be fully integrated into the Army.

Navy

OPNAV Instruction 6110.1H, Physical Readiness Program, (August 15, 2005), is the primary regulation that directs the Navy program. According to this guidance, the goal of the fitness program is to create a culture of fitness to enhance a sailor's ability to complete the Navy mission. "Mission readiness and operational effectiveness are built on the physical fitness of the individual; therefore, all Navy personnel shall maintain personal physical fitness by regular exercise and proper nutrition."[9] This philosophy is certainly driving the Navy in the combat fitness direction. The Navy is the first Service thus far examined that appears to take a somewhat serious stance on nutrition and is a very good sign that Navy leadership understands the importance of a healthy, operationally effective human weapons system.

[9] Department of the Navy, "Physical Readiness Program," *OPNAVINST 6110.1H,* (Washington: Headquarters U.S. Navy, 15 August 2005), 2.

To this end, the instruction goes on to state that the unit fitness programs must be designed to increase and maintain cardio-respiratory fitness; enhance muscular strength and endurance; flexibility; reduce excess body fat; promote year-round fitness and health; and provide nutritional guidance.[10] Physical fitness training activities shall include a minimum of three sessions per week devoted to moderate training and moderately high intensity physical conditioning. "Physical conditioning sessions should be at least 60 minutes in length to allow for proper warm-up and cool-down, and target at least 30-45 minutes of continuous aerobic activity."[11]

The Navy's Physical Fitness Assessment (PFA), which is conducted twice each year, includes a Body Composition Assessment (BCA) and a Physical Readiness Test (PRT). BCA is a two-part event that includes the maximum weight for a given height and a body fat percentage estimation based on circumference measurements. The PRT consists of the sit-reach, sit-ups, push-ups, and either a 1.5-mile run or a 400-yard swim.

The Navy has recently published an outstanding resource to assist sailors in fitness training and nutrition. This resource is a series of documents in the Navy Operational Fitness and Fueling Series (NOFFS). These documents are much like the Army's Field Manual 21-20, but they have incorporated many of the modern fitness training thoughts and concepts to better prepare the Navy for the current environment. In fact, the theories are much like the thesis of this paper: the stated goal is sailor durability

---

[10] Ibid.

[11] Ibid., 4.

and resiliency. The purpose for developing this comprehensive document is to eliminate the guesswork for the sailor and fitness professionals in the Navy.

> The NOFFS project goals are to:
> 1. Improve operational performance.
> 2. Provide foundational and performance nutrition guidance.
> 3. Decrease the incidence/severity of musculoskeletal physical training related injuries.[12]

Compared with the regulatory guidance and the fitness manuals of the previous two Services reviewed, the Navy has taken a more holistic and proactive stance towards fully protecting its valuable human capital resource through a comprehensive, scientifically developed fitness program.

Marine Corps

The final Service fitness program for review is the Marine Corps. The two publications that guide the Marines are Marine Corps Order 6100.13, Marine Corps Physical Fitness Program, (August 1, 2008), and Marine Corps Reference Publication 3-02A, Marine Physical Readiness Training for Combat, (June 16, 2004). The first paragraph in the objectives section of the Combat Conditioning Program chapter of MCO 6100.13 provides a clear picture of the Marine Corps philosophy in regards to physical fitness.

> As professional warrior-athletes, every Marine must be physically fit, regardless of age, grade, or duty assignment. Fitness is an essential component of Marine Corps combat readiness. Furthermore, physical fitness is an indispensable aspect of leadership. The habits of self-discipline and personal commitment that are required to gain and maintain

[12] Department of the Navy, "Navy Operational Fitness Series," (Washington: Headquarters US Navy), 2.

> a high level of physical fitness are inherent to the Marine Corps way of life and must be a part of the character of every Marine. Marines who are not physically fit are a detriment and detract from the combat readiness of their unit.[13]

From this statement, it is easy to see how the Marine Corps philosophy has established a fitness culture that links fitness to all aspects of military service, from leadership to personal character to combat readiness. The reference publication is essentially the Marine Corps version of the Army's FM 21-20. It is a comprehensive publication covering a wide range of fitness topics; however, due to the age of this document, written in 1987-1988, it does not include modern fitness TTP. In recognition of this fact, the current MCO 6100.13 addresses this by saying,

> …recent trends and advancements in sports training and physiology as well as findings from the Centers for Disease Control and the American College of Sports Medicine recommend that aerobic and muscle-strengthening activities be conducted more frequently, under higher intensity and of shorter duration. Doing so provides greater health benefits and results in higher levels of overall physical fitness.[14]

This recognition suggests that the Marine Corps leadership understands that fitness TTP has continued to evolve and mature with the rise of technology, and that it should incorporate those developments into its programs.

The annual Physical Fitness Test (PFT) is a measure of "general fitness" Marine Corps-wide. "The PFT was specifically designed to test the strength and stamina of the upper body, midsection, and lower body, as well as efficiency of the cardiovascular and

---

[13] United States Marine Corps, "Marine Corps Physical Fitness Program," *Order 6100.13.* (Washington: Headquarters United States Marine Corps, August 1, 2008), 1-1.

[14] Ibid.

respiratory systems."[15] The PFT consists of three events: dead-hang pull-ups (flexed-arm hang for the women); abdominal crunches; and a 3-mile run.

To assess a Marine's physical capacity in a broad spectrum of combat-related tasks, the Marines developed the Combat Fitness Test (CFT). This test was designed to evaluate strength, stamina, agility, coordination, as well as overall anaerobic capacity.[16] The CFT was meant to compliment the PFT, not take its place. Additionally, it was designed to measure the individual Marine's ability to execute many of the functional elements of combat fitness. The CFT measures three events: movement to contact; ammunition lift; and maneuver under fire.

The Marine Corps culture of fitness is certainly leading the way in the DoD. In particular, its rigorous belief that Marines are professional warrior athletes, the direct linkage between leadership and fitness and, finally, the addition of the Combat Fitness Test all indicate clearly that the Marines fully understand the value of fitness. However, as with all great programs there is always room for improvement, and the Marines are not exempt; the latency of their physical training manual and lack of current physical training TTP show the opportunity for improvement to ensure that the Marine Corps is doing everything possible to make its warriors more combat effective and extend their operational longevity.

---

[15] Ibid., 2-1.

[16] Ibid., 3-1.

Chapter Summary

This chapter examined physical fitness guidance given to the Services by the DoD. The DoD guidance established a foundation for each Service to build a fitness program that would protect and preserve the operational combat capability necessary to execute effectively and efficiently. Additionally, there is leeway within the guidance for each Service to develop programs that best meet its needs. However, as stated earlier, the ground combatants from each Service have a common core of tasks that should be utilized to provide common training and testing standards across the DoD so that when joint forces are mixed on the battlefield each Service can at a minimum execute those common core tasks at the standard identified. The next chapter will identify the current fitness and injury problems facing the DoD as the final element of the combat fitness problem.

CHAPTER III

Systemic Fitness Issues Affecting the Military

Chapter Overview

The first part of this chapter will identify the problems associated with the average enlistee, and why the less fit and more obese American child is causing issues, not only with recruiting, but also with military fitness training. Following this section, the chapter will delve into the soldier's load, a historical problem that is still plaguing the military today. Equipped with a good understanding of both of these issues and knowledge of the current military fitness programs, this chapter will focus on the problems central to this thesis, the high level of injury rates currently being experienced and their effect on the budget and readiness rates. These problems clearly indicate that the military must take appropriate action and incorporate modern physical fitness Tactics, Techniques, and Procedures (TTP) to improve the ground combatant's battlefield effectiveness and prolong individual operational longevity.

General Fitness Assessment of Average American—Military Enlistee

President Harry S. Truman once said, "No nation is healthier than its children."[1] Unfortunately, the reality is that American youth are experiencing a decline in fitness and a rise in obesity. The two issues feed off each other; as fitness declines, body fat increases, and when body fat increases, it becomes harder to exercise, thus making it

[1] U.S. Army Training and Doctrine Command, "An Imminent and Menacing Threat to National Security," *TRADOC Information Pamphlet* Fort Monroe, VA, (2008), 3.

harder to lose body fat. According to General Chiarelli's testimony to Congress on March 11, 2009, for over 30 years, the Army has seen an increase in average muscle mass and body fat percentages for new recruits. Experts have identified unhealthy diet changes, less outdoor activities, a lack of mandatory physical exercise programs in school, and an increase in more sedentary activities, such as, computer games and television, as contributing factors to the increases in body fat.[2] The key question is whether this is affecting the military.

In short, opinions can vary. According to Neil Baumgartner, Ph.D., a leading exercise physiologist for the Air Force, the average enlistee is at a less than desirable fitness level. This condition causes considerable problems during fitness training at Air Force Basic Training.[3] The Army is having similar difficulties according to Mr. Frank Palkoska, Director, US Army Physical Fitness School.[4] A study conducted by U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), however, provides conflicting information. The study surveyed national data and Army basic training testing data to ascertain the current and future state of Americans who are of military recruiting age and determine potential changes in physical fitness. Results suggested that the VO_2max of male youth and recruits has not changed, while that of the female youth

[2] Chiarelli, 5.

[3] Neal Baumgartner, interview by Chris Larkin, Via telephone from Norfolk, VA, December 17, 2009.

[4] Frank Palkoska, interview by Chris Larkin, Via telephone from Norfolk, VA, January 26, 2010.

and recruits improved from the 1960s to the 1990s.[5] The troubling fact is that during this period the performance of endurance running declined, meaning that the average run times were slower. There are many suspected reasons for this, such as sedentary lifestyle or less physical activity, but the research does a poor job of isolating the most influential of those factors. However, it does show a need to modify the initial fitness programs to work with less aerobically fit enlistees. Researchers also looked at push-ups and sit-ups during the same time and showed that there was an increase in muscular endurance. Finally, the research showed that since 1980, the prevalence of both overweight and obese recruits has steadily increased. While conflicting, this information shows that the military is faced with serious issues in regards to the fitness and body composition of current and future enlistees.

Why are the youth of America getting fat? There are a few reasons that echo what General Chiarelli stated to Congress: the increased consumption of processed foods; the lack of physical fitness activity at home and in schools; and the sedentary lifestyles associated with the rise of technology. The USACHPPM study mentioned in the previous paragraph suggests that the increases in body fat and weight primarily are due to increased caloric intake. The Centers for Disease Control and Prevention (CDC) says "large portion sizes for food and beverages, eating meals away from home, frequent snacking on energy-dense foods and consuming beverages with added sugar are often

---

[5] Joseph J. Knapik and others, *Secular Trends in the Physical Fitness of American Youth, Young Adults and Army Recruits*, (Ft. Belvoir: Defense Technical Information Center, 2004), ES-2.

hypothesized as contributing to excess energy intake of children and teens."[6] Physical activity is one way to limit overweight and obese conditions. Unfortunately, school budgets have led to the restriction of and in some cases the demise of sports programs and physical education. According to the CDC, the number of high school students that participated in daily physical fitness education dropped from 42% in 1991 to 33% in 2005; this drop has a direct bearing on the physical condition of the juniors and seniors who are likely to enter the Service. Finally, the rise of technology, including 24-hour cable television, computers, video games, and cell phones have encouraged the youth of America to be less active. In fact, a new study by the Kaiser Family Foundation, released in early January 2010, found that children ages 8 to 18 spent an average of seven and a half hours per day with these devices.[7] When multi-tasking is included in the equation, the total time of media exposure per day climbs to 11 hours. This inactivity causes unnecessary weight gain: the child who spends seven and half hours per day immersed in digital technology also has a lower metabolic rate due to less muscle mass, and tends to snack in excess. The youth of the United States have a weight problem, a complex issue affected by multiple factors. All of these factors can be addressed and are being watched by the DoD. If President Truman was correct, that "no nation is healthier than its

---

[6] Centers for Disease Control and Prevention, "Overweight and Obesity," Centers for Disease Control and Prevention, http://www.cdc.gov/obesity/childhood/causes.html (accessed November 2009).

[7] Victoria J. Rideout, Ulla G. Foehr and Donald F. Roberts, *Generation M2: Media in the Lives of 8- to 18-Year-Olds* (Menlo Park, CA: Henry J. Kaiser Family Foundation, 2010), 2.

children," then the United States must take the appropriate actions to curb these issues or be faced with the long-term consequences.[8]

Typical Soldier's Load

> ***For it is conspicuous that what the machine has failed to do right up to the present moment is decrease by a single pound the weight the individual has to carry on his back in war.--S. L. A. Marshall[9]***

Another fitness related problem in the DoD is the soldier's load. As stated in the introduction, the soldier's load is an issue that has faced senior military leaders throughout history. Under closer inspection, this issue can be divided into two distinct problem sets: first, the gear is too heavy and bulky; and second, the individual ground combatant is not physically prepared to handle the stress of today's heavy, bulky load. General Chiarelli stated in congressional testimony on March 11, 2009, that the average soldier's load consists of a rucksack, weapon, ammunition, helmet and other gear; the total weight can range from 63 pounds to more than 130 pounds, depending on the mission. The body armor, depending on the ballistic inserts, can weigh anywhere from 26 pounds to more than 41 pounds by itself. Ballistic inserts intended to make soldiers safe by limiting the risk exposure, unfortunately add weight and bulk, making the gear cumbersome and hindering the ground combatant's movement abilities.[10] The added

---

[8] U.S. Army Training and Doctrine Command, "An Imminent and Menacing Threat to National Security," *TRADOC Information Pamphlet*, 3.

[9] Brigadier General S.L.A. Marshall, *The Soldier's Load and the Mobility of a Nation* (Quantico, Virginia: Reprinted By the Marine Corps Association, 1980), 6.

[10] Chiarelli, 3.

weight and bulk hindering movement creates another dimension of risk and potential for injury. Based on these facts, it is evident that the current soldier's load causes concern for senior military leaders.

Doctrine, historical perspective, and science all provide key data points that better explain the severity of this issue. The first critical factor that must be identified is how much weight the average soldier can carry in combat. According to the Army's Field Manual 21-18, *Procedures and Techniques of Foot Marches*, the fighting load for a conditioned soldier should not exceed 48 pounds, and the approach march load should not exceed 72 pounds.[11] Regrettably, this manual does not explain how these figures were developed. Post World War II, the prolific military historian S.L.A. Marshall stated, in the *Soldier's Load and the Mobility of a Nation,* the infantryman should not carry more than 33% of his body weight. At the time, the book was written, the average soldier weighed in at 153.6 pounds.[12] This would have established the maximum load at about 51 pounds of gear, including clothing. While many of S.L.A. Marshall's writings have been questioned, this document remains one of the most quoted when discussing this subject and the fact is that his estimates remain very close to all of the recommendations in the current doctrine and the associated literature.

---

[11] U.S. Army, "Foot Marches," *Field Manual 21-18* (HQ, Department of the Army, Washington, D.C., June 1, 1990), 2-7.

[12] Marshall, 71.

In an effort to apply the requisite science to this problem, *Department of Defense Design Criteria Standard: Human Engineering (MIL-STD-1472F)* was reviewed. This document identifies the engineering criteria for development of military systems, equipment, and facilities and recommends no more than 30% of body weight for the assault load and 45% of body weight for the approach march load.[13] Table 1, below, collates this data and what Army Field Manuals, engineering data and scientific research have identified as the maximum body weight percentages recommended for the assault load and the approach march load. Surprisingly, they all state the same figures.

Table 2. Acceptable Assault and Approach March Loads.[14]

REFERENCE	ASSAULT LOAD	APPROACH MARCH LOAD
FM 21-18	30%	45%
FM 7-10	30%	45%
MIL-STD-1472F	30%	45%
DOD-HDBK-743A	30%	45%
MIL-HDBK-759C	30%	45%
Scientific Research	30%	45%

To continue in a scientific manner, the average ground combatant weight must be determined. Data obtained from the *Military Handbook: Anthropometry of U.S. Military Personnel (DOD-HDBK-743A*, shows that in 1988 the average Army soldier weighed 172.7 pounds. Using the respective body weight percentages identified above, this translates into an average recommended loads of 53 pounds for the combat load and 78

[13] Demetri Economos, "Combat Load Report," (Quantico, VA: Marine Corps Combat Development Command, Materiel Requirements Division, , December 31, 2003), 3.

[14] Zaffram, Christopher and others. *Estimation of Marine Infantry Rifle Squad Load Weight.* Quantico VA, June 21-23 2005 [Presented at 73rd Military Operations Research Society Symposium, West Point, NY].

pounds for the approach march load. When looking back to determine where the currently recommended 48 pounds in the FM 21-18 came from, it seems that, when written the authors used the 1966 weight data from *DOD-HDBK-743A.* This would have established the average soldier weight at 159 pounds, thus setting the recommended 30% for assault load at 48 pounds.

To clarify what General Chiarelli said about the gear and weight that soldiers are carrying the chart following is provided to give perspective showing what the minimum items carried by the ground combatant weigh.

Table 3. Current and Total Weights for Minimum Assault Gear.

Item Carried	Quantity	Weight (Lbs.)
Clothing		8
Helmet	1	3.6
Body armor w/2 plates	1	26
Weapon(M-4 w/SOPMOD)	1	12
5.56 Ammunition w/Magazines	210	8.5
Inter-team Radio w/battery	1	2
Water w/carrier(100 oz)	1	8
Total Weight		68.1

The chart above was created using gear that was about average across the Services. Of course, there is some gear that is lighter and some that is heavier. However, for the purposes of this paper, the intent was to show the weight carried by most ground combatants is around 68 pounds as the bare minimum. In reality the soldiers, sailors, marines or airmen operating in today's combat environment are carrying much more weight than the above chart displays. The list does not contain items such as night vision goggles, handheld global position system, compass, flashlight, food, as well as mission

specific equipment. It is apparent that the ground combatant carries a tremendous amount of weight that is clearly above the aforementioned recommendations.

A study conducted in 2004 by the U.S. Army Soldier Systems Center weighed the combat loads carried by 764 out of 1,305 82nd Airborne paratroopers in Afghanistan. The average rifleman's fighting load was 63 pounds and the approach march load was 96 pounds, both weights clearly exceeding the recommendations.[15] With the previously provided definitions of assault and approach march loads it is unclear exactly where today's combat load belongs, as today's missions do not wholly fit into either category. However, in an effort to be ready for the worst-case scenario, the ground combatant must be prepared with the right equipment, mental state and physical skills in order to prevail on the battlefield. For the purposes of this paper, the discussion will center on the ability of the ground combatant to execute his or her mission with a combat load with the understanding that the requirements for the approach march load are significantly greater.

With this in mind, what happens when the load is too heavy and exceeds the assault load recommendation of 53 pounds? The individual physical limitations of soldiers, stress, and the weight of equipment all affect the soldier's ability to carry his or her required load. Most importantly, they impede the ground combatant's ability to operate on the battlefield. Soldiers become exhausted more quickly when carrying a heavy load under the stress of combat. Besides fatigue, there is a decrement to the

---

[15] Charles Dean, "Study Says Load Too Heavy," *Infantry* 93, No. 2 (March 2004): 5.

warrior's agility, placing them at a disadvantage when rapid reaction to the enemy is required. Thus, a soldier's ability to react to the enemy is reduced by the weight and bulk of his or her load. Research indicates that as the weight and bulk of the load increases there is a systematic decline in the ground combatant's ability to execute mission related tasks.[16] In fact, there is a correlation between the reduction in ground combatant's physical capability and the amount of weight added to the soldier's load. This decrease is estimated at 1 to 3% per kilogram of weight added.[17] Beyond a decrease in performance, there is an added energy cost that further affects the soldier's combat effectiveness. This subsequent increase in energy expenditure "affects how fast the soldiers can move, inhibits their movement over obstacles, affects how fatigued they are upon arrival or when attacked, increases food (calorie) needs, and increases the risk of injuries such as blisters, knee pain, low back injuries, and stress fractures."[18] Finally, research shows that load carriage degrades both balance and rapid decision-making abilities.[19] This is significant when the cumulative effects are considered and applied to the modern battlefield. The answer to the question of what happens when the load is too heavy and exceeds the assault load recommendation of 53 pounds is that it degrades the ground combatants' combat effectiveness and puts them at an increased risk of injury.

---

[16] Joseph J. Knapik and Katy Reynolds, *Load Carriage in Military Operations: A Review of Historical, Physiological, Biomechanical, and Medical Aspects* (Ft. Belvoir: Defense Technical Information Center, 1997), 52.

[17] Ibid.

[18] M. D. Beekley and others, "Effects of Heavy Load Carriage During Constant-Speed, Simulated, Road Marching," *Military Medicine* 172, no. 6 (2007), 594.

[19] Bryson May, Phillip D. Tomporowski and Michael Ferrara, "Effects of Backpack Load on Balance and Decisional Processes," *Military Medicine* 174, No. 12 (December 2009),1312.

If the ability to move swiftly, shoot accurately, and outthink the enemy while carrying an increased soldier's load in a combat scenario is a mission essential task, then the ground combatant should be conditioned for carrying heavy loads. The DoD guidance, discussed previously, did not specifically address this particular requirement except to say that Services should incorporate job-specific fitness requirements for those career fields where it is deemed necessary to ensure adequate skill, performance, and safety. This statement leaves the Services sufficient room to address this requirement; however, Service guidance is similarly vague. The one glaring omission is an assessment designed to evaluate and drive training for the combat loaded ground combatant. Additionally, little guidance specifically directs a fitness program that might tackle the soldier's load-related issues. Several studies have shown the value of a focused training effort to increase performance in skills such as the loaded march. United States Army Research Institute of Environmental Medicine (USARIEM) showed that a specially designed and implemented physical training program, administered within normal Army time constraints, can be very effective in improving the ability to perform physically demanding military tasks and, in fact, can be much more effective than the standard Army training.[20] Army Field Manual 21-18, *Procedures and Techniques of Foot Marches,* provides a perspective for the loaded march task when it states:

> Soldiers who are physically fit to APFT standards can carry loads that are 45 % of their body weight (average 72 pounds) at 4 kph for eight-hour

[20] Everett Harman and others, *Effects of a Specifically Designed Physical Conditioning Program on the Load Carriage and Lifting Performance of Female Soldiers* (Ft. Belvoir: Defense Technical Information Center, 1997), 1.

> approach marches. The amount of energy expended and discomfort experienced in carrying these loads can be reduced if soldiers have participated in a specialized program of physical conditioning. As a result, much heavier emergency loads can be carried at reduced speeds. Soldiers whose mission is to operate on foot for long periods without resupply can benefit from such training and conditioning.[21]

Fortunately, many leaders in the field have recognized this issue and have implemented unit level combat fitness training programs. There are several larger efforts underway; the Army Rangers, Navy SEALs, Air Force Special Tactics and several large Army light infantry units, such the 101st Airborne and the 10th Mountain, have developed programs in conjunction with industry and academia that focus on increasing their warriors' combat effectiveness. Unfortunately, these are individual efforts with little best practice or basic information sharing. Clearly, based on the combat loaded soldier's requirement to shoot, move and communicate, there is a need for focused training. This need can be met utilizing modern TTP to increase combat effectiveness.

Injury analysis

The one element from the soldier's load section that was not discussed in-depth was the potential for increased injury rates based on the increased combat load. Injuries are a serious problem for the DoD, and as such will be analyzed in this section. Somewhat counter intuitive, soldier's load injuries are an issue, however the broader "musculoskeletal injuries resulting from basic and advanced individual training pose the

[21] U.S. Army, "Foot Marches," *Field Manual 21-18*, 5-18.

single most significant medical impediment to military readiness."[22] This systemic issue is the result of the fitness state of the current enlistees, the soldier's load, and the physical training currently being conducted by each Service. In the introduction, it was identified that the Army has 20,000 soldiers who are non-deployable based on musculoskeletal injuries sustained while deployed. This is a serious issue for the Army, and it only scratches the surface of the problem for the DoD. This issue can be broken into two distinct problem sets: first, the budgetary issues related to the current and future healthcare costs associated with the treatment, rehabilitation, sustainment and retirement; and second, the current and future operational decrement that directly affects the military's combat readiness and capability. Money and readiness are clearly issues that the DoD struggles with year after year. Therefore, based on today's environment of a tightening budget, reduced manpower, and rising healthcare costs, it is imperative that the DoD take the appropriate actions to deal with the injury rates, the costs associated, and their effects on the DoD's operational capabilities.

Injuries are a serious health problem for the U.S. military forces in both peacetime and in combat. In fact, historically, injuries have had the biggest impact to the health and readiness of the force. In order to appreciate the issues facing the DoD, the problem must first be defined. According to the April 2009 Armed Forces Medical Surveillance Monthly Report, which provides an annual injury summary, there were approximately 7.8 million ambulatory visits for illness and injuries in 2008. The largest percentage of these

---

[22] Paul R. Sackett and Anne S. Mavor, *Assessing Fitness for Military Enlistment; Physical, Medical and Mental Health Standards* (Washington, DC. The National Academies Press, 2006), 79.

visits was caused by musculoskeletal and connective tissue injuries, totaling approximately 1.9 million visits.[23]

Data from 2006 clarifies this information. In 2006, there were 743,547 musculoskeletal injuries treated in either outpatient visits or hospitalizations.[24] To be clear, this number indicates actual injuries as opposed to medical visits related to an injury. These injuries only include non-deployed active duty personnel. Looking more closely at this data reveals that 82% of musculoskeletal injuries were classified as inflammation/pain, which many would consider overuse injuries, followed by joint derangements at 15% and stress fractures at 2%. Interestingly, in the military, "physical training or exercise-related injuries are the single biggest category of overuse injuries."[25] This fact is significant to the thesis of this paper and will be discussed further in a later chapter. The majority of injuries occur in specific areas of the body: the data shows that the knee/lower leg accounts for 22%, the lumbar spine accounts for 20%, the ankle/foot accounts for 13%, the spine accounts for 11% and, finally, the shoulder accounts for 9%.[26] The above data provides a good picture of the how many injuries the active duty component is currently experiencing. Clearly, 743,547 musculoskeletal injuries affecting

---

[23] Armed Forces Health Surveillance Center Silver Spring MD, *Medical Surveillance Monthly Report. Volume 16, Number 4, April 2009* (Ft. Belvoir: Defense Technical Information Center, 2009), 10.

[24] Ibid.

[25] Army Center for Health Promotion and Preventive Medicine Aberdeen Proving Ground MD, "Preventing Injuries in the U.S. Military: The Process, Priorities, and Epidemiologic Evidence," (Ft. Belvoir: Defense Technical Information Center, 2008), ES-4.

[26] Ibid.

an active duty military population of approximately 1.3 million indicates a serious problem.[27]

Deployed musculoskeletal injuries only make this problem worse. The DoD identifies injuries to deployed forces as either battle injuries or non-battle injuries (NBI). In 2006, leading air-evacuated NBI for both OIF and OEF was fractures. Sports or physical training was the leading cause of NBI for both operations, at 19 to 21%.[28] A recent study indicates that between 2004 and 2007 24% of all evacuations from Afghanistan and Iraq were due to muscular problems such as back pain, tendinitis, and repetitive stress injuries. Combat wounds came in second at about 14%.[29] Similarly, statistics taken in Iraq from September 2005 through early January 2006 further confirmed the severity of musculoskeletal injuries, with 94% of the injuries treated being non-combat related and of these over 50% were chronic conditions. Nearly 45% of these were to the back, 35% to the lower extremities and 21% to the upper extremities.[30] Previously mentioned statistics and studies did not include the deployed NBI statistics; this data is additive to the larger injury problem. What this means is that these deployed musculoskeletal injuries are certainly exacerbating the problems in the DoD. Thus, it is

---

[27] U.S. Army Center for Health Promotion and Preventative Medicine, "Physical Training and Sports Injury Prevention Guidelines: Cost of Injury," http://chppm-www.apgea.army.mil/ptipt/Docs/Formatted%20Combined%20Job%20Aides/Opening%20Statistics_final.pdf (accessed January 12, 2010), 2.

[28] Army Center for Health Promotion and Preventive Medicine Aberdeen Proving Ground MD, "Preventing Injuries in the U.S. Military: The Process, Priorities, and Epidemiologic Evidence," ES-6.

[29] Ibid.

[30] Nikki Butler, "Injury as a Combat Multiplier," (Master's Thesis, Carlisle Barracks, PA: U.S. Army War College, 2008), 6.

imperative that the DoD take actions to minimize this problem in order to ensure the health and operational capability of the military.

The following chart shows the total number of ambulatory hospital or clinic visits and the average number of injuries per person from 2003 to 2008. The data identifies a steady increase in musculoskeletal injuries over the past six years. The causes of this increase in injuries sustained by the force cannot be determined. With the exception of 2005, it can also be inferred that there has been a rise in the number of injuries sustained by an individual. Both of these facts are significant when considering operational and budgetary impacts.

Table 4. Total Ambulatory Injury Visits Per Year and Average Injuries Per Person.[3132]

2003		2004		2005		2006		2007		2008	
Injuries	# per person	Injuries	# per person	Injuries	# per person	Injuries	# per person	Injuries	# per person	Injuries	# per person
1,479,964	1.05	1,642,153	1.13	1,480,096	1.07	1,653,676	1.18	1,776,047	1.31	1,901,735	1.34

The budgetary impacts based on the current injury rates in the DoD may not be readily apparent, but a closer inspection exposes a serious crisis for the military leadership. According to the U.S. Army Center for Health Promotion and Preventive Medicine, the average cost per injury is more than $3,000.[33] This estimate accounts for

---

[31] Armed Forces Health Surveillance Center Silver Spring MD, *Medical Surveillance Monthly Report. Volume 16, Number 4,* (April 2009), 11.

[32] Armed Forces Health Surveillance Center Silver Spring MD, *Medical Surveillance Monthly Report. Volume 15, Number 3, April 2008* (Ft. Belvoir: Defense Technical Information Center, 2009), 10.

[33] USACHPPM, "Physical Training and Sports Injury Prevention Guidelines: Cost of Injury," 4.

the medical costs associated with the injury, the cost of days with limited duty due to injuries, the cost of lost duty days due to injury and, finally, the cost of medical hold and holdover due to injuries. The Center used 508,766 musculoskeletal injuries in 2005 to extrapolate that the total annual cost of injuries exceeded $1.5 billion![34] Unfortunately, how the number of injuries was determined for this report is not known, but if the previously identified number of 743,547 musculoskeletal injuries in 2006 were used, the total annual cost of injuries would exceed $2.2 billion![35] Both figures are astronomical, and when considered in the context of today's fiscal environment it cannot be denied that this is a significant problem that must be mitigated not only for fiscal reasons, but also for operational capability and long-term health of the individual. If the injury rates could be reduced by 5 %, there would be a potential savings of approximately $111 million; if the reduction was 15 % it could save the government approximately $330 million; finally at 30 % the savings would be approximately $660 million! What is missing here is the long-term medical costs associated with veteran care and treatment. "For the current wars in Iraq and Afghanistan, conservative estimates show the long-term costs of providing veterans medical care and disability range anywhere from $350 to $660 billion dollars."[36] All of this data supports the assertion that the DoD has experienced a large increase in the number of musculoskeletal injuries over the last six years. Additionally,

---

[34] Ibid.

[35] Author extrapolated data derived from the following sources: Armed Forces Health Surveillance Center Silver Spring MD, *Medical Surveillance Monthly Report. Volume 16, Number 4, April 2009*, 10: U.S. Army Center for Health Promotion and Preventative Medicine, "Physical Training and Sports Injury Prevention Guidelines: Cost of Injury," 4.

[36] Butler, 16.

there are significant costs associated with these injuries. The remaining chapters in this paper will discuss potential measures the DoD could implement to mitigate these injuries. Unfortunately, there is one additional fact that must be presented when considering the costs associated with injuries: 97% of health care costs spent on musculoskeletal injuries focus on restorative measures while only 3% focus on preventative measures."[37] This is important because it shows the DoD's focus. Without a doubt, the budgetary impacts based on the data provided are a serious problem. When considering the potential of both fiscal opportunities and increased operational capability through improved long-term health of the ground combatant, it begs the question of why the military is not doing more.

As previously mentioned, this high injury rate not only has budgetary impacts, but also affects the operational readiness capability of the military. Consider the fact that "across the entire DOD, it was estimated that acute and overuse/chronic injuries together resulted in over 25,000,000 days of limited duty in 2005."[38] Add to this the 20,000 non-deployable Army soldiers based on musculoskeletal injuries, and this issue starts to take shape. The USACHPPM identified nearly 2.3 million days of limited duty, 2.1 million lost duty days, and 760,000 medical hold/holdover days were all due to musculoskeletal injuries in 2005.[39] Unfortunately, with today's injury rate data, these figures would be

---

[37] Ibid., 6.

[38] Army Center for Health Promotion and Preventive Medicine Aberdeen Proving Ground MD, "Preventing Injuries in the U.S. Military: The Process, Priorities, and Epidemiologic Evidence," 1-2.

[39] U.S. Army Center for Health Promotion and Preventative Medicine, "Physical Training and Sports Injury Prevention Guidelines: Cost of Injury," 5.

considerably larger. Moreover, considering the most recent troop increase of 30,000 headed to Afghanistan, the severity and consequences of this issue become even more magnified. Thus, it is clear that injuries are a tremendous drain on military manpower during peacetime, and especially so during times of armed conflict.

Chapter Summary

This chapter addressed the systemic issues that demand action by senior leaders. The first issue identified was the poor fitness and health of the youth in America. This issue is not only affecting the military, but it is a problem that the nation as a whole must deal with or face long-term consequences. The sedentary lifestyle, the lack of physical fitness classes in school and the rise of technology all contribute to this issue; however, each of these can be mitigated through awareness and action. The soldier's load, a historical problem that still plagues the military today, is something that the military must attack with lighter equipment, leadership training, and better physical fitness skills for the ground combatant. Finally, the most serious issue to affect operational capability, which is directly complicated by the previous two sets of problems, is the injury rate currently being experienced. While not obvious, the costs associated with these injuries have a huge impact on the budget, especially when considering the rising health care costs and the constrained budgetary environment. Considering these problems, and the current physical fitness doctrine, guidance and training, which are insufficient for our service men and women, leads to the conclusion that the military must take appropriate action and incorporate modern physical fitness Tactics, Techniques, and Procedures (TTP) to

improve the ground combatant's battlefield effectiveness and prolong individual operational longevity.

CHAPTER IV

Increased Operator Longevity

Chapter Overview

Now that a scientific physical fitness picture has been presented, it is appropriate to connect all the issues in an effort to establish a departure point for discussion on how to increase ground combatant operational longevity. Chapter I identified the current concepts of fitness and ultimately provided a concept for combat fitness. Chapter II addressed the current DoD and Service doctrine and guidance utilizing many of the terms and concepts established in Chapter I. Chapter III examined the current physical fitness issues, breaking down the causes and subsequent long-term effects. This chapter will identify concepts that, if applied to the Service fitness programs, could have significant positive effects, specifically reducing injuries and increasing operational availability throughout the individual's career. Ultimately, if the ground combatant remains healthier and experiences fewer injuries, the result is increased operational availability and reduced medical costs. The seven concepts presented in this chapter have been identified based on gaps seen in current military physical fitness training. Each concept will provide a brief description supported by scientific data. If these concepts are adopted, incorporated and inculcated into the Service cultures, it is possible that the ground combatant's operational longevity can be extended by decreasing the chance of injury or lessening the severity, thus expediting the individuals return to operational status.

Education

The first and arguably most important concept is a top to bottom educational campaign to teach both the how and why of the new fitness concept. A specific enduring educational program is required for several reasons. First, this concept is needed to teach the basic skills, movements, principles and components. This portion must be instituted across the board from basic training, through all military education, and up to senior officer professional education. The effort should be designed not only to teach the basic skills, but also to reinforce or update the information, skills, and concepts as the program matures. Institutionally the Services will push back on this requirement, identifying a lack of time available in the training courses; however, these classes can be conducted in lieu of the actual fitness training. If these courses are comprehensive there will be immediate performance gains seen through properly executed combat fitness techniques. Additionally, the lasting health and injury mitigation benefits this new requirement will provide far outweigh the initial costs caused by courseware changes and initial cadre train up. Second, education is required to teach and initiate change in the way the youth of America view the reasons for and benefits of fitness. Based on the mindset of the average enlistee, it is imperative to change their views on fitness in order to preserve the combat capability of tomorrows military. The primary focus area should be on musculoskeletal injuries, the potential of injury, and the causes associated with military training and combat operations. A specific point should be made to discuss the resulting negative impact on quality of life issues that could result from these injuries. In the end,, the process should close with a detailed explanation of how the human weapons system can be better prepared and either totally alleviate or at least mitigate the aforementioned

injuries if appropriate combat fitness training measures are developed and continuously practiced throughout the individual's career. Finally, the education effort should also focus on information regarding the types of injuries currently being experienced in the military, the risk factors that cause the injuries, and the strategies to mitigate or prevent the injuries. In support of this point, the Joint Services Physical Training Injury Prevention Work Group (JSPTIPWG) "recommends injury prevention education for military personnel, including all levels of military leadership, as a part of institutionalized continuing military education and distance learning programs."[1] The JSPTIPWG is primarily focused on the education that uses evidence-based prevention strategies. In fact, the group believes that

> …the reduction of injuries is most likely to occur if all levels of leadership (command and cadre) understand the injury risk factors Service members face and which strategies are effective in preventing injuries. Education is the first step in identifying and disseminating evidence-based interventions that can be implemented at the unit level and is an essential component of any successful injury reduction program. Through education, leadership can be empowered with the knowledge and skills necessary to effectively reduce injuries in their sphere of influence.[2]

Clearly, education can and should play a major role in the reduction of injuries. In an Army study, it was identified that injuries were reduced 30 % in Basic Combat Training (BCT) when leadership combined specific education with other injury prevention

---

[1] Steven H. Bullock and Bruce H. Jones, "Recommendations for Prevention of Physical Training (PT)-Related Injuries: Results of a Systematic Evidence-Based Review by the Joint Services Physical Training Injury Prevention Work Group (JSPTIPWG)" (Ft. Belvoir: Defense Technical Information Center, 2008), 23.

[2] Ibid.

interventions.[3] Although it may seem difficult to connect the injury rate reduction with education, it is clear that there are effective strategies for injury prevention. Additionally, ensuring leadership has a clear understanding is critical to reducing the current debilitating injury problems the DoD is suffering. Therefore, the DoD must institute a robust physical fitness education campaign that not only teaches the how and the why of the new combat fitness concepts, but also addresses the potential impacts of injuries and the specific benefits of combat fitness. This campaign must be conducted throughout the Services from basic training through the most senior professional education courses.

Functional Movement Screening

Once combat fitness education is firmly entrenched throughout the DoD training and education system, the next step is to improve the ground combatant's operational longevity through an initial functional assessment. What exactly is a functional assessment? It is a comprehensive exam that tests multiple domains of function, such as balance, strength, and range of motion. These domains of function are tested simultaneously to determine individual limitations or asymmetries. Why is this valuable? It has been identified that these limitations or asymmetries can cause injuries. Additionally, inefficient movements cause compensations across the body, which causes a joint to be moved in an unnatural manner. These compensatory movements lead to micro trauma to the tendons and ligaments supporting the affected joints. In the physical training arena, the ground combatant will usually sacrifice quality for quantity in an effort

[3] Ibid.

to perform more repetitions of the required exercise. Of course, this only exacerbates the situation and generally leads to injury. In an effort to reduce the injury rates caused by these factors, the initial assessment can be used to identify military members at risk for injury. The resulting data is essential to develop training plans to diminish, or better yet, train away these physical issues. Additionally, the data collected should be maintained throughout the individual's career to evaluate and improve fundamental movement skills based on injury recovery or changes in ability due to aging or lack of physical activity. Therefore, an initial functional assessment is a valuable tool to reduce injuries and improve the ground combatant's operational longevity.

Probably the most well known assessment utilized by professional and college sports organizations is the Cook Functional Movement Screen (FMS). In an effort to provide an overview of what an FMS is and the value offered, this paper will use the Cook FMS as a representative process that highlights the value of the assessment. This paper does not specifically advocate the Cook FMS over any other process. The Cook FMS looks at the quality of fundamental movement patterns to identify an individual's problem areas. Mobility and stability extremes are tested to determine if there are subsequent weaknesses in the areas evaluated. The Cook FMS includes a series of seven dynamic flexibility tests designed to categorize functional movement patterns. The exam requires a combination of muscle strength, flexibility, range of motion, coordination, balance, and proprioception in order to complete the movements. It utilizes a variety of basic positions and movements that are thought to provide the foundation for more

complex athletic movements, such as ground combatant tasks, to be performed efficiently.[4]

The seven tests are:

1. The deep squat, which assesses bilateral, symmetrical, and functional mobility of the hips, knees and ankles.
2. The hurdle step, which examines the body's stride mechanics during the asymmetrical pattern of a stepping motion.
3. The in-line lunge, which assesses hip and trunk mobility and stability, quadriceps flexibility, and ankle and knee stability.
4. Shoulder mobility, which assesses bilateral shoulder range of motion, scapular mobility, and thoracic spine extension.
5. The active straight leg raise, which determines active hamstring and gastroc-soleus flexibility while maintaining a stable pelvis.
6. The trunk stability push-up, which examines trunk stability while a symmetrical upper-extremity motion is performed.
7. The rotary stability test, which assesses multi-plane trunk stability while the upper and lower extremities are in, combined motion.[5]

Each event is scored from zero to three. Zero is the least capable and three is considered normal. In the end, the scores from all events are totaled and a composite score is obtained. This score can then be used to establish baseline information, identify weaknesses and or asymmetries, and to focus a training plan to mitigate, repair or train away the identified problems.

Research indicates that there is a relationship between the Cook FMS score and injury risk. In fact, in a recent study using National Football League (NFL) players, the

---

[4] Gray Cook, "The Functional Movement Screen: The system for a simple and quantifiable method of evaluating basic movement abilities," Functional Movement Systems, http://www.functionalmovement.com/SITE/publications/downloads/FMSPB.pdf (accessed January 2010).

[5] Ibid.

FMS was used to determine a factor that showed a higher propensity for injury. The study showed that players with an FMS score equal to or less than 14 were approximately 11 times more likely to be injured and players with any asymmetry were 3 times more likely to be injured.[6] In pilot testing conducted by the Air Force Research Lab, 131 U.S. Air Force Elite Pararescue Trainees were assessed on the FMS.[7] The results confirmed that those with a score equal to or less than 14 were less likely to succeed in training. Unfortunately, few details are provided concerning this test; however, the results do show that trainees who scored below the standard and washed out of training usually succumbed to a musculoskeletal injury.

Currently the Navy SEALs, Navy Special Warfare Combatant Crewmen, Army Rangers and Air Force Combat Controllers are actively using a functional screening in their combat fitness programs. The Navy Special Warfare community believes that the value of this type of assessment is that it provides "a higher level of operational functional performance and improved military readiness."[8]

There are several concerns with adding a FMS to the Service fitness programs. First, the DoD needs to identify a requirement to conduct a functional movement

---

[6] K. Kiesel, P.J. Plisky and M.L. Voight, "Can Serious Injury In Professional Football Be Predicted By A Preseason Functional Movement Screen?" *North American Journal of Sports Physical Therapy* 2, No. 3 (2007), 151.

[7] U.S. Army Center for Health Promotion and Preventative Medicine, "Physical Training and Sports Injury Prevention Guidelines: Functional Movement Screen," http://chppm-www.apgea.army.mil/ptipt/Docs/Formatted%20Combined%20Job%20Aides/injury%20screening_final.pdf (accessed January 25, 2010), 1.

[8] Michael Strock, interview by Chris Larkin. Naval Amphibious Base Little Creek, VA. November 30, 2009.

assessment on their members. Second, a specific protocol needs to be identified. This could be problematic based on the individual Service requirements; however, in the absence of additional scientific data the DoD should require a basic evaluation and, if the Services so desire, they can exceed the minimum. Next, there is the problem of trained or proficient fitness professionals who have the expertise to evaluate the functional movements. This can be mitigated through some initial contracting efforts that include broad-spectrum initial training and evaluation of trainers by the contracted fitness professionals. Eventually, this contracted requirement will no longer be necessary as the education and training efforts take root across the Services and they start growing combat fitness warriors. Available time is the biggest issue as a barrier to change. Fortunately, much like education, this screening can be conducted during already scheduled physical training time. The value in preventing injuries and developing a corrective strategy will again far outweigh the time lost. Finally, additional research is required to determine if a single assessment can be used for all the Services or if it will be necessary to develop separate assessments for each Service and possibly for specific career fields. Clearly, these issues can be seen as potential roadblocks to the institutionalization of a functional movement screening for all ground combatants prior to and throughout the individual's career. Ultimately, the question is what is the value added if the DoD carves out time and money to add this concept; the answer is that this one measure can significantly increase the operational longevity of the ground combatant, and, in the end, this will both boost the combat capability of the DoD and save considerable fiscal capital.

Perform Multiaxial, Neuromuscular, Proprioceptive, and Agility Training

Once the assessment is complete, the next issue that must be addressed is how the DoD should alter the current training to develop a combat fitness-training program that will extend longevity and enhance performance. According to the JSPTIPWG "it is recommended that multiaxial (many plains of motion), neuromuscular (coordinated muscular movement), proprioceptive (body position sense), and agility (non-linear movement) exercises be included as a regular component of military PT programs."[9] The work group reviewed 116 research studies and found evidence that including these types of exercises reduced injuries. In an effort to clarify what the JSPTIPWG is recommending, each term must be understood. Thus, the next several paragraphs will break the recommendation into parts to define and support why the DoD must incorporate this concept into practice, guidance, and doctrine.

Neuromuscular and proprioceptive training are interrelated and key to understanding why the JSPTIPWG made this recommendation. All movement occurs through the interaction of muscles and joints. This interaction is guided by the body's senses. The senses provide critical data that is processed through the brain and spinal cord. The central nervous system acts as the information superhighway receiving data from the senses, sending it to the brain, and then returning the control messages from the brain to the muscles and joints to execute the movement. The senses that mediate this movement are the somatosensory, the vestibular, and the visual systems.

---

[9] Bullock and Jones, 45.

> The somatosensory system often referred to as proprioception, functions to detect sensory stimuli such as touch, pain, pressure and movements such as joint displacement... The vestibular system receives information from the vestibules and semicircular canals of the ear… The visual system also contributes to the maintenance of balance. This system provides the body with visual cues for use as reference points in orientating the body in space. It is generally agreed that, under normal conditions, the somatosensory and visual subsystems are the primary mediators of balance and postural awareness.[10]

These systems that control the body's movement and balance are all trainable. First, the information superhighway, better known as the motor neuron pathways, need to be utilized to be effective. To better understand the concept, imagine a path through the woods: if the path is well used the travel is easy, but if it is overgrown the travel may be very difficult. Similarly, the ground combatant must train the small muscles that surround the joints to build the muscle memory and develop that worn path. Finally, training must include the senses. Each of these components has a role in neuromuscular training, and when tied together they facilitate movement. Thus, training the neuromuscular system will ensure smooth, balanced movement under the strain of the soldier's load in the combat environment and prevent many potential injuries.

Research data supports this assertion. Trainers recently used neuromuscular and proprioceptive training program to show a significant decrease in anterior cruciate ligament injuries over a 2-year period. The results were remarkable, reducing anterior cruciate ligament tears by 74 %.[11] Besides neuromuscular specific training, the program

---

[10] S. M. Lephart, D.M. Pincivero and S.L. Rozzi, "Proprioception of the Ankle and Knee," *Sports Medicine* 25, No. 3 (March 1998), 149.

[11] Bullock and Jones, 45.

used a number of other activities such as strengthening, stretching, and education. In a separate 6-week, preseason neuromuscular training intervention program, trainers showed a 72 % reduction rate of non-contact ACL injuries in females.[12] Further data shows that wobble boards used to improve balance, coordination, and proprioception have been effective in preventing subsequent ankle sprains.[13] From a military perspective, research on exercises that develop core body stabilization, agility, and multiaxial movement skills without the balls, balance mats and wobble boards showed reductions of injury rates by 20 to 30 % in basic trainees.[14] These studies support the assertion that neuromuscular and proprioceptive training can prevent injuries.

Multiaxial, or what some professionals term triplanar, is the next concept explained. A brief discussion of basic biomechanics is necessary to understand the concept. There are three planes of motion in which the human makes movements: the frontal plane, the sagittal plane, and the transverse plane. Much of the current military physical training occurs in only one of these planes. For example, running takes place in the sagittal plane and jumping jacks take place in the frontal plane. Additionally, a considerable portion of current training takes the reductionist approach. This means that exercises and activities are designed to de-construct a movement in order to apply focused stress on a singular joint and muscle group. This method of exercise is not ideal as it creates imbalance and unnatural stress on muscle and joints. It does not generate an

---

[12] Ibid.

[13] Ibid.

[14] Ibid., 44.

ideal adaptive response, but most importantly, it does not mimic the reality of the ground combatant. The issue is that most human movements are multiplanar. Clearly the way the human body is built, with all the various joints and muscles, it is designed to allow for and support multiaxial or triplanar movements. The core element of the combat fitness definition is that the training required must link to the mission essential tasks associated with the ground combatant. A quick review of the Army Warrior Tasks, Appendix 3, reveals that most of the tasks listed require the ground combatant to be able to perform multiaxial movements. Clearly, there is a requirement for multiaxial or triplanar movement.

Besides multiaxial movement, the JSPTIPWG recommended agility training. Agility is defined as the ability to stop, start, change direction and efficiently change body position.[15] This skill integrates the required elements from both the multiaxial and the neuromuscular control recommendations. A closer examination reveals that Twist and Benickly, in their 1995 study, stated, "agility is the ability to maintain or control body position while quickly changing direction during a series of movements."[16] Barnes and Attaway went on to say in their 1996 study "agility training is thought to be a re-enforcement of motor programming through neuromuscular conditioning and neural adaptation of muscle spindles, golgi-tendon organs, and joint proprioceptors.[17] Clearly,

---

[15] U.S. Army Training and Doctrine Command, "Army Physical Readiness Training," *Training Circular 3-22.20*, 2-5.

[16] Michael G. Miller and others, "The Effects of a 6-Week Plyometric Training Program on Agility," *Journal of Sports Science and Medicine*, 5, (2006), 460

[17] Ibid.

agility training combines multiaxial and neuromuscular training to achieve a synergistic affect decreasing or preventing injuries.

Beyond these obvious benefits, there are several supplementary benefits associated with this type of training that are not related to neurophysiological learning.

> Incorporating these activities into a finite training period reduces the trainees' excessive exposure to running activities, thereby reducing lower body injury risk.
>
> The musculoskeletal stresses of training are more evenly distributed across the body (and in different axes of motion) by these types of drills, thereby reducing injury risk (unlike running, which focuses stress narrowly in the lower body).
>
> Strength and stabilization exercises directed at the body core (trunk) represent many of the same movements required during more complex combat activities, and this may increase the likelihood of improved military occupational task performance and possibly reduce injuries.[18]

These additional benefits bolster the already undeniable benefits of this type of training. If the DoD decides to pursue a strategy to increase combat effectiveness and extend operator longevity, it is clear that the physical fitness program must include this concept.

In summary, multiaxial, neuromuscular, proprioceptive, and agility training each offer significant mitigation to the injuries currently being experienced by the DoD. There is significant research that supports this assertion. These elements also establish a fitness foundation for the ground combatant that will protect and prepare him or her for the rigors of the battlefield. Combat fitness training should be based on the METs. If training is based on the METs, it will have to include all of these elements. The

---

[18] Bullock and Jones, 44-45.

synergistic effect of multiaxial, neuromuscular, proprioceptive, and agility training have the potential to significantly extend the operational longevity and increase the combat effectiveness of the ground combatant.

Functional Warm-up

With the value of multiaxial, neuromuscular, proprioceptive, and agility training clearly understood, the next step to increased longevity is to incorporate those elements into a functional warm-up prior to every combat fitness training session. Most people in the military believe that static stretching prior to physical activity equates to a warm-up. Static stretching is usually performed in an effort to increase muscle and joint flexibility, decrease muscle stiffness, and increase elasticity of muscles and other tissues prior to exercise. Unfortunately, static stretching alone does not completely prepare the body for functional exercise. In some cases, light exercise may be included to the standard military warm-up process. The desired intent of these exercises is to raise the body temperature, improve blood flow, and increase the exchange of oxygen and carbon dioxide. Regrettably, even together these activities do not prepare the body fully for functional exercise. The missing components include the need to take the joints through the full range of motion and work the body's functional mobility and functional stability. In a functional warm-up, light exercise and stretching are still required; however, they must be interwoven into the process. The functional warm-up desired effect is to:

> Increase core temperature; elongate muscles actively; improve balance and proprioception; increase mobility, flexibility, stability, and strength; activate muscle groups and movements that have been "turned off" from disuse and dysfunction; use muscles in "stretched" positions that will facilitate strength in new ranges of motion for the smaller stabilizing

> muscles; establishes and maintains ability to perform functional whole body movements.[19]

This means that the warm-up should include multiaxial (many planes of motion), neuromuscular (coordinated muscular movement), proprioceptive (body position sense), and agility (non-linear movement) exercises. The value of this type of warm-up is evident based on the previous section's discussion on each of these elements and their value.

Sample functional warm-up routines are provided in Appendix A and B. These documents were obtained from the Combat Athlete Program at the Special Tactics Training Squadron, Hurlburt Field, Florida. These programs use elements of multiaxial, neuromuscular, proprioception, and agility to prepare the body for the upcoming training. These activities take between 10 and 15 minutes to execute properly. If this process were included as a portion of the education concept discussed earlier and conducted prior to every fitness event throughout initial training, it would become inculcated into the DoD fitness paradigm.

Core Performance, a highly renowned physical training system, uses the term movement prep in place of functional warm-up but the concept is the same. According to Mark Verstegen, president of Athlete's Performance, "movement prep actually makes you stronger and helps yield long-term flexibility gains. You'll actively elongate your

---

[19] Ron Jones, "Movement Preparation Exercises," Ron Jones High Performance Health, http://www.ronjones.org/Handouts/MovementPrep.pdf (accessed January 19, 2010).

muscles in a series of movements, which can improve balance, mobility and stability."[20] By strengthening muscles in this new range of motion, you stabilize all the tiny muscles around your joints that help hold the joints together, similar to the discussion on neuromuscular training. These activities can improve posture, performance and decrease the potential for injury. If a ground combatant's sole exercise was the functional warm-up, it would make their body stronger, more stable, and increase speed and power output.[21]

When considering the benefits of multiaxial, neuromuscular, proprioceptive, and agility training, it is obvious that a new warm-up method is required. The information gained in the previous section validates that this new warm-up method should not only increase core temperature, but should also elongate muscles actively, improve balance and proprioception, and increase mobility, flexibility, stability, and strength. The goal should be to enable the body to perform functional whole body movements. Additionally, if you compare the traditional static stretching warm-up routine and the functional warm-up, it is easy to see how this functional paradigm focuses on a comprehensive system providing a more complete process to warm-up prior to exercise. Therefore, the DoD must adopt a new functional warm-up process.

---

[20] Athlete's Performance. "Methodology: A System Based Approach." http://www.athletesperformance.com/assets/sp-12.pdf (accessed January 2010).

[21] Ibid.

Prehab versus Rehab

Prehab versus rehab is the next concept required to extend the longevity of the ground combatant. This concept leverages the synergism created through combining the functional assessment, multiaxial training, neuromuscular training, proprioceptive training, agility training, and the functional warm-up. Prehab versus rehab is specifically designed to strengthen the most injury prone areas of the body. The primary focus areas, based on injury data previously presented, are the hips, knee, ankle, low back and shoulders. The theory is that strengthening these areas, prehab versus rehab, will improve the ground combatant's posture and alignment, allowing his or her joints to move more efficiently. Additionally, it will strengthen the tendons, ligaments and tiny muscles that surround the joints thus providing a measure of injury proofing. Therefore, the ground combatant, equipped with better posture, alignment, efficient joint movement and a stronger support structure surrounding the joints, should be better prepared to handle the strain of the soldier's load and stress of the combat environment. Ultimately, the goal of the prehab training is to prevent or mitigate the majority of the musculoskeletal injuries currently being experienced by the ground combatant, thus alleviating altogether or minimizing, the rehabilitation the injured combatant must undergo while in recovery. Based on this thought process, the benefits of this synergizing concept are readily apparent and therefore must be fully developed and integrated into the DoD physical training, guidance, and doctrine.

A key element not yet specifically addressed is how the ground combatant must incorporate the soldier's load into the training plan. Using the information garnered in the functional assessment and DoD injury data, a plan can be developed based on the

identified or historically significant weak points in the ground combatant's body. The combat fitness training plan based on the METs, would incorporate the functional warm-up and elements of the multiaxial, neuromuscular, agility and balance to better prepare the ground combatant. The exercise principle of progression is critical to integrating the soldier's load into the combat fitness training effectively. Progression is the requirement to increase the intensity and/or duration of the training gradually. If a slow methodical process is not followed, the designed intent to prevent injuries may in fact become the cause: immediately loading a ground combatant with 60 pounds of gear to conduct combat fitness training may be excessive and result in traumatic injury. Additionally, if fitness training is conducted without the soldier's load, the ground combatant will be ill prepared for the rigors of the combat environment. The intent is to perform the prehab exercises, neuromuscular, proprioceptive, agility, and balance, with some elements of the soldier's load. As the individual gets stronger and more capable, incremental increases in weight and bulk can be added. The end state is for the ground combatant to conduct training in full combat gear. This is different from the standard field operations training normally conducted in full combat gear. The specific intent here is to train and strengthen the body methodically during combat fitness training utilizing the concepts discussed. The ultimate goal is to prepare the body, specifically the weak areas, to handle the weighted stress while executing the various mission essential tasks in the combat environment. Thus, the soldier's load is an important required element of the ground combatant's combat fitness training plan. Moreover, when utilized during prehab versus rehab the potential benefits are readily apparent. The key to prehab versus rehab is leveraging the synergism created through combining functional assessment, multiaxial

training, neuromuscular training, proprioceptive training, agility training, and the functional warm-up to strengthen the most injury prone areas of the body.

Prevent Overtraining

Preventing overtraining is the next concept that will be examined in an effort to increase operational longevity for the ground combatant. Overtraining is an issue that both civilian and military physical trainers have been dealing with for a very long time. The relevance of this concept is that with minor modifications to current Service fitness training plans there is potential for a significant decrease in overtraining injuries. This is especially important when examining the types and amounts of training currently being conducted at basic training. As previously identified, the fitness level of the average enlistee is not comparable to that of past enlistees. This means that there is a much greater potential for injury if the same training plan is prescribed. Arguably, the basic training injury rates of 25 % for men and 50 % for women are representative of this issue.[22] Additionally, distance running, which has been a staple of the military fitness program for a very long time, has been identified as one of the major factors in overtraining. In fact the JSPTIPWG identified that "during basic training, about 80 % of injuries seen are in the lower extremities and are of the overuse type—a condition a condition brought about by PT volume overload (generally excessive running relative to initial fitness level and running capability of the individual)."[23] The majority of the data

[22] Bullock and Jones, 30.

[23] Ibid.

presented in this section pertains specifically to running; however, the concept should be applied to each element of the combat fitness program and the program as a whole. The words "prevent overtraining" seem like common sense and seem like they should be easy to put into practice during the execution of a fitness-training plan. However, the practical application is much more difficult. Based on this fact, it is important to examine this concept fully in an effort to better understand the impacts of overtraining and the values of preventing this problem.

Military research efforts have been successful at highlighting the value of reducing running mileage in physical training programs. The critical factors that make these studies valuable are that when the Services reduced running mileage, there was a reduction in injuries and a minimal time increase in the distance evaluations. This suggests that the aerobic capacity was not affected by this reduction in work. The Marine Corps tested this theory during their 12-week boot camp. Table 5 below shows the running distances, stress fracture incidence, and final 3-mile run times for three separate groups of U.S. Marine recruits. A 40% or 22- mile reduction in running distance was associated with a 54% reduction in stress fracture incidence with an insignificant change (3%) in run times.[24]

[24] Ibid., 31.

Table 5: Mileage, Stress Fracture Incidence, and Average Final 3-Mile Run Times Among Three Groups of Male U.S. Marine Corps Recruits[25]

Marines (n)	Total run distance over 12 weeks (mi)	Stress fracture incidence (%)	Final 3-mile run times (min:sec)
1136	(High) 55 miles	3.7%	20:20
1117	(Medium) 41 miles	2.7%	20:44
1097	(Low) 33 miles	1.7%	20:53
	22 mile reduction	54% reduction	Not a statistically significant change

Therefore, reduced mileage lowered the injury rate with very little effect on aerobic fitness. According to the JSPTIPWG, this strategy also saved the Marine Corps a substantial amount of money and operational capability. The Marine Corps estimated that the 1995 medical care cost savings were approximately $4.5 million and the training days saved were nearly 15,000 days.[26]

A more recent Army study, shown in Table 6, displayed similar results. Two groups of Army trainees were followed during the research. The group in which the total running was significantly reduced resulted in a marked decrease in injuries. Remarkably, the evaluation times were actually faster in the reduced mileage group.

[25] Ibid., 30.

[26] Ibid.

Table 6: Mileage, Injury Incidence, and Average Final 2-Mile Run Times Among Two Groups of Male and Female U.S. Army Recruits[27]

Running Mileage	Injury incidence	Final 2 mile run time (min.sec)
High 130 miles	54%	13.45
Low 56 miles	41%	13:28
74 mile reduction	24% reduction	Not a statistically significant change

In a Navy study, Table 7, the results were again similar. Again, two groups of trainees were followed during the research. As previously seen the lower mileage group had lower injury rates. This time the study looked at time improvements during the one and one-half mile evaluation and the results showed a mere two second improvement. Therefore, once again a reduction in running mileage reduced injuries without negatively affecting physical fitness.

Table 7: Mileage, Injury Incidence, and Average Improvement in 1.5-Mile Run Times Among Two Groups of Male U.S. Navy Recruits[28]

Running Mileage	Injury incidence	Average improvement in 1.5 mile run
High 26-44	22.4%	1.02
Low 12-18	16.4%	1.00
Average 20 mile reduction	27% reduction	Not a statistically significant change

Clearly, it is evident that there are thresholds where there is little aerobic value added for the increased distance and the subsequent increased prevalence of injuries. Distance running is a key element in the Services' physical fitness programs. This

[27] Ibid., 31.

[28] Ibid., 32.

information identifies how the Services' views on distance running have created some overtraining problems. Moreover, the fitness level of the average enlistee exacerbates this situation by introducing less capable trainees into a program already in excess of the scientific recommendations. Therefore, the DoD must continue to monitor and study this situation to refine the distance, intensity and time thresholds. Additionally, the DoD must force the services to limit the running distances and adhere to the principles of fitness. Finally, time saved by reduction of running mileage can be used to develop the required combat fitness skills utilizing the previously discussed concepts.

It is important not to lose sight of this concept as it applies across the entire fitness program, not just to the distance running. Other strategies that were not discussed in this section but have value in preventing overtraining are:

1. Avoiding combinations of strenuous military training and PT
2. Exercising in a gradually progressive manner
3. Running in groups based on level of ability (run times)
4. Avoiding the practice of giving extra PT sessions to the least fit Service members
5. Refraining from or modifying the use of PT as a corrective tool
6. Utilizing interval training more
7. Allowing adequate musculoskeletal recovery[29]

The value of these benefits cannot be overstated when working to minimize the injuries associated with physical training. Moreover, decreasing the running distances is only one overtraining prevention measure that can be effectively used to mitigate injuries.

---

[29] Ibid., 33-38.

In summary, preventing overtraining is an important concept in extending the longevity of the ground combatant. This is a primary responsibility of leadership, especially as the ground combatant matures through his career. In the case of preventing overtraining, it is critical for leadership to engage with and monitor the types and amounts of physical fitness training their troops are conducting. Overtraining is a complex issue that is having an effect on the DoD. The information provided in this section shows the negative impacts of overtraining and the value of effective overtraining prevention. The Services and the DoD must take the appropriate actions to modify the guidance and doctrine to protect the most valuable weapons systems, the human.

Nutrition

Nutrition is a concept that has value in both enhancing performance and extending longevity. For many of the same health related reasons the DoD requires physical fitness programs it should require good nutrition programs. Maintaining a healthy body weight and body fat percentage through good nutrition and physical fitness helps to ensure optimal health, fitness, and physical performance. In fact, poor nutrition is linked to many diseases and conditions including cardiovascular disease, hypertension, dyslipidemia, type 2 diabetes, overweight and obesity, osteoporosis, constipation, diverticular disease, iron deficiency anemia, oral disease, malnutrition, and some cancers.[30] Poor diet and limited physical inactivity are the most important factors

[30] U.S. Department of Health and Human Services and U.S. Department of Agriculture, "Dietary Guidelines for Americans, 6th Edition, 2005," (Washington, DC: U.S. Government Printing Office), 2.

contributing to the increase in overweight and obesity in the nation. Healthy eating contributes to overall healthy growth and development, including healthy bones, skin, and energy levels. It also lowers the risk of dental caries, eating disorders, constipation, malnutrition, and iron deficiency anemia. The value of nutrition both in field and at home station cannot be overstated. Eating right in the field can maintain and enhance operational performance and morale and significantly contribute to mission accomplishment. The ground combatant who can practice good nutrition at home and while deployed will be better able to endure the harsh environments and extreme conditions encountered on today's battlefield. These issues are essential to promoting optimal health of military personnel and maintaining military readiness at home and on the battlefield.

Individual services and in some cases individual units have developed nutrition programs. For instance, the Navy has recently published their manual *Navy Operational Fueling.* The key concept to this program is the view that food is nourishment to the body as opposed to solely calories. The Navy considers what food represents in terms of energy and nutrients. There are five areas of nutrition focus in the Fueling Series.

1. Eat Clean
2. Eat Often
3. Hydrate
4. Recover
5. Mindset[31]

[31] Department of the Navy, "Navy Operational Fueling," (Washington, DC: Headquarters US Navy), 3.

The Army Rangers and Navy SEALs both have nutrition programs aimed at enhancing the performance of their operators. *The Navy SEAL Nutrition Guide* was published back in 1994. Clearly, the Navy and these units believe that there is value in providing at a minimum education about good nutrition to their members.

Ultimately, this problem begins with the American society. The obesity issues affecting the youth of America are similar to the issues that make it difficult for the military to emplace and enforce a nutrition program. Processed foods, energy drinks, and fast food certainly influence the nutrition choices that the ground combatants are making today. Add to that, the fact that the majority of food consumed is not during the duty day and outside the control of the Service. This is an issue somewhat outside the control of the Service. The Service must endeavor to change the dietary habits of its members in an effort to build and maintain a healthy force and ultimately to enhance performance. Education is the key to changing the habits of military members. The DoD and Services need to establish programs and include this information into the combat fitness education concept discussed earlier. The military has led the way in societal change before and this should be no exception.

Besides the health related benefits, good nutrition can enhance operational performance on the battlefield and extend the longevity of the ground combatant. Combat fitness training is difficult and can be very hard on the body. Nutrition is one of the concepts that makes this training possible and beneficial. One of the key roles nutrition can help with is during the recovery from combat fitness workouts. Combat fitness training can deplete the body's glycogen stores and fatigue its muscles. This fatigue reduces the muscle's ability to protect joints. Research shows there is a link

between glycogen depletion and muscle damage, fatigue and musculoskeletal pain. Civilian and military research provide evidence that good nutrition can restore energy balance, overcome fatigue, minimize muscle damage, and protect against heat injury. Additionally the literature indicates the timing of nutrition plays an important role in the value added. In fact, the literature shows that consuming a combination of carbohydrates and protein within 60 minutes of strenuous exercise optimizes the repair of damaged muscles and begins the replenishment of glycogen stores.[32] The JSPTIPWG recommends "consuming 12 to 18 grams of protein and 50 to 75 grams of carbohydrate (a ratio of 1 gram of protein for every 4 grams of carbohydrate) and a fluid replacement beverage within 1 hour after very strenuous, continuous physical activity (e.g., road marching/hiking lasting longer than 1 hour) to minimize muscle damage and optimize recovery."[33] Clearly, there is evidence that post exercise nutrition can restore the ground combatant's energy balance and it can optimize recovery by inhibiting muscle breakdown. According to the JSPTIPWG, post-exercise nutrition can also reduce risk of heat-related illness and enhanced physical performance.[34]

A closer examination of the nutrition concept shows that it can provide both extended longevity and enhanced performance. Certainly, nutrition offers numerous health related benefits and it is in the Service's best interest to pursue good nutrition for

---

[32] Siu M. Parco, "Effect of Frequency of Carbohydrate Feedings on Recovery and Subsequent Endurance Run," *Medicine & Science in Sports & Exercise* 36, no. 2 (February 2004), 323.

[33] Bullock and Jones, 69.

[34] Ibid.

their members. A good nutrition program starts with education and this could easily be added to the combat fitness education discussed in section one of this chapter. Beyond education, the services must provide better nutritional opportunities at home and in the deployed environment. Finally, continued research is necessary to capitalize on industry and academia in an effort to provide the best solutions for the ground combatant. Nutrition is essential to promoting optimal health of military personnel and maintaining military readiness at home and on the battlefield.

Chapter Summary

The seven concepts presented in this chapter clearly have the potential to affect the DoD injury rates. Education is the foundational component to making the changes and additions and subsequently establishing a new fitness paradigm. Functional movement screening establishes a baseline for corrective training and career-long standards based assessment. Multiaxial, neuromuscular, proprioceptive, and agility training along with functional warm-up, range of motion, and prehab versus rehab are the core elements to the training that must be included in future physical fitness programs. Prevention of overtraining is critical, but if the core elements are applied, it will become apparent that there is not enough time to allow this historic practice to continue. The value of nutrition cannot be overstated when considering total health and fitness as well as value to injury prevention in the combat fitness program. Therefore, if these concepts are adopted, incorporated and inculcated into the Service cultures there is a realistic chance that the ground combatant's operational longevity can be extended by decreasing

the chance of injury or lessening the severity, thus expediting the individual's return to operational status.

CHAPTER V

Enhanced Combat Effectiveness

Chapter Overview

With the ground combatant healthy and injury free, the next relevant issue that needs to be addressed is performance enhancement. As with any capability the DoD employs on the battlefield, it should strive to employ the most technologically advanced capability to the battlefield. Based on capability gaps in the human on the battlefield today, the DOD should be striving to improve the human weapons system. Modern physical fitness TTP must be leveraged to improve the human weapons system. This chapter will focus on three main areas: situational awareness, cognitive ability, and mental toughness. Situational awareness focuses on the sensory abilities of the human and can be broken into three parts: vision training, coordination training, and reaction training. Cognitive capability is the human ability to think and execute in a physically and mentally stressed state. Finally, reaction training delves into the human ability to see, hear, and then react quickly. On the surface these skills may seem to be the realm of the Olympic or professional athlete and not something that the military would waste valuable time and effort pursuing. However, with a fitter, more combat capable warrior on the battlefield these skill sets are the next steps for continued improvement of the human weapons system. These concepts will help to ensure continued United States military dominance on the modern battlefield.

Situational Awareness

The ground combatant cannot execute on the battlefield effectively without the eyes sending visual information to the brain. Once received the brain processes the information and sends motor commands to the various muscles. In order to perform optimally in combat these systems must be finely tuned. Good visual skills are critical to eye-hand coordination, visual recognition, fixation, tracking, depth perception and reaction speed. Vision is composed of many skills, and just as exercise and practice can increase an athlete's speed and strength, it can also improve his vision skills. The typical ground combatant spends hours upon hours conducting physical training, shooting, marching with equipment and participating in training exercises, all in an effort to fine-tune his or her combat effectiveness. Unfortunately, there is very little if any time spent training the eyes and the associated visual reflexes.

According to Michael F. Zupan, PhD, a professor in the Human Performance Laboratory at the US Air Force Academy, "visual sensory input may account for up to 85-90% of the sensory input an athlete is receiving during an athletic contest. This is especially true for athletes like hockey players, lacrosse or soccer goalies, baseball players and fencers."[1] This high percentage of sensory input is connected to sports with high visual demands and arguably, a firefight in combat has a similarly high visual sensory demand. Based on vision research at the Air Force Academy, Doctor Zupan surmised that "the individual who can process more visual information in a shorter period

[1] Michael F. Zupan and others, "Visual adaptations to sports vision enhancement training: A study of collegiate athletes at the US Air Force Academy," *Optometry Today* (May 19, 2006), 46.

and make the proper response will have an advantage in competition" or in the case of the ground combatant, on the battlefield. So is it possible to train vision and sensory skills? Doctor Zupan goes on to say that

> as athletes tap out their potential in other aspects of their performance, like speed, power or strength, what will they turn to next to increase their performance? The trend seems to be that they will turn to vision training. The results of this study indicate that if an individual performs vision training, then their visual systems will continue to improve with practice similar to other types of training.[2]

Therefore, the question becomes how much training for how much advantage? A quick Google search reveals a fair number of commercial companies offering vision training to improve sports performance, but not for military performance. Most of these training programs provide testimonials as proof that the program works. Unfortunately, there are few definitive research efforts that provide scientific evidence to support the quantifiable value.

Interestingly, the program that seems to have the most research and science behind it is Nike's Sensory Sport Training (SST) program run by Dr. Alan Riechow, Global Director for Vision Science. The key difference is that Nike has been able to document a relationship between vision training and performance improvement in certain sport. The process starts with a pre-training assessment, much like the functional assessment discussed earlier in this paper. However, this assessment specifically targets the eyes and the information processing pathways. The assessment measures 14 vision skills. The definitions are provided here:

---

[2] Ibid., 48.

1. **Static Visual Acuity:** Clearer sight provides clarity of targets and objects. This affects higher-level skills such as depth perception, quickness, and timing.
2. **Contrast Sensitivity:** Sensitivity to subtle differences helps to pick out targets and objects that tend to blend into the background.
3. **Dynamic Visual Acuity:** Ability to see detail in a moving target. Being able to see a static object does not correlate with being able to see a moving target.
4. **Near Far Quickness:** Ability to change visual attention between far and near targets quickly and accurately. Any delay in focusing the eyes transfers to a delay in the overall reaction.
5. **Depth Perception:** The speed and accuracy of judging depth and distance. Important for the 3-D spatial awareness required for the developing situation.
6. **Speed of Perception:** The speed of processing of visual information. Quicker perception of a situation leads to a quicker response.
7. **Span of Perception:** The accuracy of processing of visual information. More visual information being processed quickly leads to a more accurate response.
8. **Peripheral Vision:** Processing of information in the peripheral visual fields. Important for spatial awareness and searching for and locating the next target.
9. **Central Eye-Hand:** Quickness of visual reaction and the speed of the motor response. Important for being quick in close quarter combat.
10. **Eye-Hand Coordination:** Accuracy and speed of visually-guided hand movements. Important for being accurate in close quarter hand-to-hand combat.
11. **Eye-Body Coordination:** Speed and accuracy of visually guided body movements. Important for quickly and accurately moving the entire body into or out of situations.
12. **Split Attention:** Ability to perform two simultaneous visual tasks. Being aware and responsive to the periphery (soft focus) while keeping attention on the primary task (hard focus).
13. **Anticipation Timing:** Precision, accuracy, and timing a motor response of a rapidly approaching stimulus. Important for timing of targets in combat.
14. **Visual Equilibrium:** Balance skill under different visual conditions. Important for maintaining balance during quick movements or in dark environments.[3]

---

[3] Nike Sensory Sport Training, "Visual Training Slides," Portland, OR, 2008. [Presentation provided to author by Nike]

Even though these definitions are based on sports skills, it is easy see the link to the military skills required for the ground combatant to operate on the battlefield.

The results of the assessment are plotted on a graph and areas of improvement are identified. From data points on this chart a training plan can be developed to expand the sensory skills of the ground combatant. The initial training that Nike recommends usually takes about 3-4 months with 3-4 sessions per week. Each session lasts about 30 minutes. At the completion of the training, another assessment is conducted to determine the sensory gains made. What is unknown is if and how much of these gains will fade without continued specific training.

The unique portion of the Nike research includes a study conducted with collegiate football players. In this research, they have been able to connect the performance enhancements to the vision training and show the quantifiable increases in vision skills. This means that there is a high probability that the DoD could directly connect specific training to increased combat effectiveness. Moreover, it should be relatively easy for the DoD to develop some tests that have heavy sensory demands and are MET based to confirm the value and quantify the sensory improvements.

There is a clear link between the visual skills discussed above and the neuromuscular training discussed in the previous chapter. The visual system is one of the systems that guides movement by providing the brain with situational awareness data to better understand what is happening to and around the body. It can therefore be extrapolated that with better visual skills, the data that is transmitted from the visual sense to the brain, would be sent quicker and would be of better quality. Thus, situational

awareness training is not only beneficial to senses; it can also have benefits in regards to movement, balance, and agility.

This is clearly one area that could use additional research. While the theory is sound and there is good supporting documentation related to sports, it does not readily relate to the military mission. Additionally, there needs to be a study to look at the long-term training requirements, the skill degradation when limited or no reoccurring training is conducted, and exactly what visual skills are most required for the military mission. A protocol of standardized shooting tests that require high visual demands might meet both stated information requirements. Even though there seems to be, some additional research required the immediate value is evident and cannot be dismissed.

Visual systems play a vital role in the ground combatant's combat effectiveness. Science and the supporting research prove that visual skills can be trained like any other system in the body. Furthermore, the evidence indicates that this training can provide significant performance increases. The benefits are linked to more than the visual systems and they can improve movement, balance and agility. This means that not only does this concept provide increased effectiveness; it also suggests that there will be extended longevity based on injury prevention. This concept is similar to radar that provides a significant increase for a ship, plane, or helicopter. Therefore if the DoD could provide a significant technological advantage for its weapons systems it would plan, program, budget, purchase and sustain the capability. Increased situational awareness for the human weapons system is no different. Finally, even though additional research is required, the value of this training is clear and the DoD must incorporate this

concept into training, guidance and doctrine in an effort to increase the combat effectiveness of the human weapons system.

Cognitive Capability

Cognitive capability is the next concept that will be examined in an effort to enhance the combat effectiveness of the ground combatant. The ability to perform the assigned tasks while under stress can be very difficult. The ability to think, decide and act is even harder. To better understand cognitive capability, the concept must be broken into two parts. The first part is cognitive thinking. There are many interrelated cognitive skills that contribute to academic and occupational success. Broadly categorized, these critical skills include attention, working memory, processing speed, long-term memory, visual processing, auditory processing, logic and reasoning. These skills are interdependent. Often they overlap, as information is received, processed, and acted upon.[4] In the sense of combat fitness, cognitive capability also deals with the addition of stress. Stress comes in many different types. Rob Shaul, of MountainAthlete.com, has developed training; he calls "Range Fitness," for five distinct types of stress.

1. Physical - cardio and muscular fatigue
2. Competitive - athletes complete the sessions side by side, and work hard to score highest or finish first
3. Mental Complexity - accurate thinking along with accurate task execution such as, marksmanship
4. Teamwork - teammates suffer while athlete works

[4] Learning RX, "Which Cognitive Skills are Most Important for Success," Define Cognitive Thing, http://www.learningrx.com/define-cognitive-thinking-faq.htm (accessed February 2010).

5. Fear - "Combat" Range Fitness sessions add an intense element of fear to the mix[5]

Each of these distinct types has a role in preparing the ground combatant to handle the stress of combat, specifically on the battlefield. Ultimately, the goal of cognitive capability is for the ground combatant to be able to handle and deal with the stresses identified and then think, decide, and act. Therefore, this capability would be very beneficial to enhancing the effectiveness of the ground combatant.

The goal of this type of training is to induce the various forms of stress in the training environment while requiring the ground combatant to perform complex tasks. These tasks include complex motor skills such as accurate marksmanship, radio operations, or medical problems, such as administering intravenous fluids. Additionally, the tasks should include elements of the think, decide, and act process. Motor skill tasks are much easier to inject into the ground combatant's training. For example, combat marksmanship, with soldier's load, accompanied by some type of physical activity that induces cardio or muscle fatigue will require the soldier to train like he fights with stress, thus better preparing him or her for combat. The cognitive skills are much more difficult and cannot readily be applied to the masses and may have to be reserved for combat leaders. This requires good planning and effective scenario management during training to induce stress and then make the leader work through the cognitive process. That said, there has never been a more combat experienced force and this experience can be

[5] Rob Shaul, "Range Fitness," Military Athlete, http://www.militaryathlete.com (accessed 4 February, 2010).

leveraged to develop and execute the complex scenario play required to test and train the ground combatant leaders.

Chapter Summary

Enhanced combat effectiveness is important for any capability that the DoD employs on the battlefield. In fact, the DoD strives to possess a technological advantage in an effort to maintain the dominant global military force. Clearly, there are some areas where the DoD can improve the human weapons system in pursuit of the dominant global military force. Situational awareness and specifically vision training is an area that has some untapped potential to increase combat effectiveness significantly. Certainly, an increased cognitive capability would provide a distinct advantage for the ground combatant who must be able to execute the METs in a physically and mentally stressed state. Based on the modern battlefield complexity, the shrinking budget, reduced manpower and increase global demands, the DoD must attempt to maximize the capability it fields in pursuit of the national interests. This means that it must leverage modern fitness TTPs to increase the ground combatant's combat effectiveness. These concepts if adopted and inculcated into training, doctrine and guidance significantly improve the human weapons system and help ensure continued United States military dominance on the modern battlefield.

CHAPTER VI

Recommendations

"The dogmas of the quiet past, are inadequate to the stormy present. The occasion is piled high with difficulty, and we must rise -- with the occasion. As our case is new, so we must think anew, and act anew. We must disenthrall ourselves, and then we shall save our country."— Abraham Lincoln[6]

Chapter Overview

The detailed concepts presented in the previous two chapters certainly offer a great opportunity for the DoD to reduce injuries and enhance combat effectiveness, however, without some cultural shifts these concepts will not be adopted, inculcated or worse, sustained into the future. This chapter will tie the combat fitness concepts together in a coherent manageable system that will serve as the basis for all ground combatant fitness training across the DoD. Finally, an argument will be presented in support of a new annual combat fitness evaluation that would supplement the current health based evaluation. These recommendations play a key role in the development, implementation, and sustainment of a new doctrinally guided combat fitness program. Without these additional requirements, the long-term viability of this program will be in question. Clearly, if the effort is made to preserve the most vital weapon system in the DoD, the human, and preserve national security, then these additional recommendations should be accepted and adopted.

---

[6] Leadership Now, "Quotes on Change," Leading Thoughts: Building a Community of Leaders. http://www.leadershipnow.com/changequotes.html (accessed March 2010).

Combat Fitness Training Concept

In order to change the current fitness programs dramatically and incorporate combat fitness effectively across the DoD it will require both art and science to develop a strategy that integrates the concepts presented in this paper into a homogenous plan that can extend the operational longevity and increase the combat effectiveness of the ground combatant. Time is the true limiting factor, especially as the military continues to do more with less. Therefore, the addition of combat fitness training requirements to an already overburdened training schedule is of considerable concern. Each Service and their subordinate units execute their fitness programs differently, some allowing duty time to conduct fitness training, some require the individual to conduct fitness training prior to or post their duty schedule, and some are not concerned with fitness training until the annual fitness evaluation. This is based on the Service culture as well as the mission requirements. At the unit level, this translates to leadership creatively including combat fitness training not only into the regular physical training time slots, but also into the operational training events. With these facts in mind, this paper will present a concept that can be seamlessly incorporated into a 3 day-a-week physical training program. The standard training sessions should not last more than 75 minutes. Each session should start with a functional warm-up, then transition into multiaxial, neuromuscular, proprioceptive, agility and balance training, then transition into strength training, followed by energy system training and finishing with regeneration. Meshing combat fitness training into the current physical training should not be difficult; however, merging these new requirements into operational training and melding the two programs will take both art and science.

The first concept identified was the functional movement screening. This was defined as a comprehensive exam that tests multiple domains of function, such as, balance, strength, and range of motion. Ideally, this should be done as early in an individual's career as possible. In the best case scenario it would be conducted in basic training or better yet prior to enlistment, thus giving the individual the opportunity to work on asymmetries or weaknesses prior to enlistment. This evaluation is time intensive, about 20 minutes per person, so it may have to wait until the individual ground combatant gets to his or her job specific training. The goal is to make corrections before repetitive fitness and work-related tasks are undertaken by the individual, potentially causing injuries based on imbalances or asymmetries. If the baseline data is maintained throughout an individual's career, and used periodically, it can ensure the individual maintains an ideal range of motion and biomechanically correct movement. Additionally, in the event of injury, the information can be used in the rehabilitation process. Based on the lack of physical activity and physical education of American youth this concept clearly has benefits and should be incorporated early in the training process.

A functional warm-up is the first concept included as part of the combat fitness workout plan. The functional warm-up desired effect is to

> increase core temperature; elongate muscles actively; improve balance and proprioception; increase mobility, flexibility, stability, and strength; activate muscle groups and movements that have been "turned off" from disuse and dysfunction; use muscles in "stretched" positions that will facilitate strength in new ranges of motion for the smaller stabilizing

> muscles; establishes and maintains ability to perform functional whole body movements.[7]

The benefits of this concept were fully developed earlier in this paper and it is without a doubt a far superior process than what is currently being done. Therefore, Office of Secretary of Defense, OSD, should strive to develop a standardized plan for the Services in order to maximize the benefit and extend the longevity. A standardized plan should be taught and utilized in basic training during every physical training session. If employed in this manner, the warm-up process will become second nature and this habit should follow the individual through his or her career. In the event that the Services do not choose to implement this concept into basic and officer training, then it will be incumbent upon the ground combatant training courses to integrate this concept into their physical fitness training plan. Sample warm-up plans are provided in Appendix A and B.

Once the ground combatant has completed the functional warm-up then he or she is ready for multiaxial, neuromuscular, proprioceptive, agility and balance training. This portion of the training should last between 10 and 15 minutes. The benefits in injury prevention and performance enhancement were explained earlier in this paper and it is evident that this type of training is necessary in order to better prepare the ground combatant for the rigors of the combat environment. This training should include movement training in all the planes, plyometric, agility and balance training. These are not all inclusive, but give the general idea for the concept. It is important to remember

---

[7] Jones, Ron. "Movement Preparation Exercises." Ron Jones High Performance Health. http://www.ronjones.org/Handouts/MovementPrep.pdf (accessed January 19, 2010).

that the principles of fitness must be adhered to realize the benefits. Precision is critical, especially in the beginning when the movements or exercises are new and the trainee is at increased risk for physical training related injury. Regularity, variety, progression and overload are all equally important in this and all the concepts presented. Specificity is also important and should include MET based activities as well as include a progressive approach to including the soldier's load in these types of activities. The ground combatant must train his body to handle the weight and bulk of the soldier's load in all planes of movement and in the various METs. Therefore, multiaxial, neuromuscular, proprioceptive, agility and balance training all play vital roles in fully preparing the ground combatant, increasing operational longevity and enhancing combat effectiveness.

The addition of the soldier's load highlights a need for strength training. While this concept was not specifically discussed earlier in this paper it does not mean that it should not be included in combat fitness training. There are numerous strength based tasks that the ground combatant must be able to execute, the least of which is to be able to operate while wearing the soldier's load, potentially in excess of 130 pounds. These are just a couple of the reasons why the next portion of the combat fitness training plan includes strength training. The real question is how to train the large numbers of ground combatants without a weight room in every operational unit. The key is innovation. Body weight exercises provide a good starting point, beyond that, suspension training, kettle bells, sandbags, jerry cans and anything else that can be used as weight to conduct the required strength training. The fitness principles are again vital to effective application of this concept. With large numbers of personnel, circuit training will provide the most flexibility while still enabling the desired affects. Push-ups, sit-ups, and

pull-ups are good basic strength exercises and all have their place in the combat fitness plan but these alone will not provide the strength required for increased longevity or enhanced combat performance.

The next element of the combat fitness plan is called energy system training. This is training that is specifically designed to develop the physiological systems in the body to enable different types of work capacity. This is another element of the combat fitness plan not discussed in this paper. The main thrust of this training for the ground combatant is aerobic and anaerobic training. Most military personnel are familiar with the aerobic training as it most closely relates to the traditional run training. Anaerobic is basically sprint training. This more closely resembles what the ground combatant has to do on the battlefield today. The reality is that both of these elements are important. The dilemma is how much, how far, and how often. The fitness principles provide good guidance to answer these questions. In a best-case scenario, the combat fitness plan would be a continuous effort that ties the multiaxial, neuromuscular, proprioceptive, agility and balance training, with strength training, and the energy system training. This can be achieved through circuit type training or dividing the workout into several sections. The difference from what has been done in the past is the specific focus on the new concepts presented as opposed to calisthenics and pure aerobic running. Instead, the efforts should be events that incorporate all elements of the concepts and directly connect the exercises and movements to the METs. Further, the addition of the soldier's load should be added progressively in an effort to build the ground combatants combat fitness capability systematically. A building block approach must be adhered to in order to

ensure that overtraining or other fitness related injuries do not become a problem. Therefore, a balance must be developed to provide the ground combatant with the full spectrum of energy system training. The end state goal is to prepare the ground combatant, extend the longevity, and enhance combat effectiveness.

The final element of the combat fitness training session is regeneration. This is probably the most ignored and least appreciated fitness principle. Unfortunately, most athletes do not prepare their bodies properly to recover from the training conducted. Many experts call this invisible training. The body must be given time to recover and rebuild from the previous workout in order to continue to make improvements.

> Adaptation to training occurs during recovery… According to Dan Benardot, "recovery is the process the athlete goes through to return to a state of performance readiness. Recovery involves a restoration of nutrient and energy stores, a return to normal physiological function, a lessening of muscle soreness, and a disappearance of the psychological symptoms (irritability, disorientation, inability to concentrate) associated with extreme fatigue" (Arnett et al. 2001).[8]

As indicated in this quote, the regeneration portion of the combat fitness workout has three elements; the functional warm-down, refueling, and rest. The functional warm-down or cool down is similar to the warm-up; however, it is aimed at preparing the body to finish the workout. This activity involves light exercise to help remove lactic acid and other byproducts from system. Additionally, the intent is to take advantage of the active state of the body and conduct yoga-like stretching to increase flexibility and range of motion as well as mitigate the negative effects of the workout. The body's nutrition

---

[8] Vern Gambetta, *Athletic Development: The Art and Science of Functional Sports Conditioning.* (Champaign, IL: Human Kinetics, 2007), 261.

needs start shortly after completion of the workout with each individual "consuming 12 to 18 grams of protein and 50 to 75 grams of carbohydrate (a ratio of 1 gram of protein for every 4 grams of carbohydrate) and a fluid replacement beverage within 1 hour after very strenuous, continuous physical activity."[9] Therefore, refueling should be advocated during the last 10 minutes of the combat fitness workout. In fact, according to Michael Strock, Naval Special Warfare Group 4, Human Performance Manager, the SEALs are working to make available low-cost high-nutrition post workout meals for their personnel.[10] This action shows that the SEALs recognize the importance of post-workout nutrition. Rest is the final element in regeneration. It is essential if improvements are desired. Overtraining discussed earlier in this paper clearly highlighted the potential issues associated when either too much training is prescribed or when there is not enough rest given between the fitness training sessions. This second point is significant when the normal day-to-day training is considered and correctly utilized to prepare the ground combatant for the combat environment. Ultimately, the combat fitness-training plan should be deconflicted with the unit-training plan in an effort to maximize the training opportunities and minimize potential overtraining. Regeneration is a complex element in the combat fitness-training plan and is necessary for extended longevity and enhanced combat effectiveness.

---

[9] Bullock and Jones, 69.

[10] Michael Strock, interview by Chris Larkin, Naval Amphibious Base Little Creek, VA. November 30, 2009.

In summary, it is clear that a combat fitness plan that incorporates all elements presented in this paper is possible. Without a doubt, doing so will require both art and science to develop a strategy that integrates the concepts presented in this paper into a homogenous plan that can extend the operational longevity and increase the combat effectiveness of the ground combatant. Time is an issue and it is understandable that the services will push back on this type of a change. However, with good leadership and innovation combat fitness training can be integrated into both regular physical training time slots and operational training events. Meshing combat fitness training into the current physical training should not be difficult; however, merging these new requirements into operational training and melding the two programs must be given a very high priority, because the long-term gains will be worth the effort.

Combat Fitness Training Assessment

With a combat fitness concept firmly emplaced in the Services, the next step to ensuring the long-term viability of the effort is to develop and implement an additional annual evaluation that would focus on the fitness elements not tested in the health-based annual Service evaluations. To ensure that the assessment evaluates the combat fitness of the individual accurately, research must be done similar to the earlier discussion on Mission Essential Tasks and the movements, fitness skills, and components required to execute the tasks. This data would be used to design assessments for each of the important health and skill-related fitness components that are relevant to the identified METs. Once again in the absence of this data the current Army Warrior Task list and

ethos should be used in conjunction with the new concepts presented in this paper to develop an evaluation that assesses combat fitness as opposed to health fitness.

There will be arguments as to why a new assessment is necessary. First, the current assessment is not adequate in evaluating the readiness of the ground combatant. Running, push-ups, and sit-ups do not measure Combat Physical Readiness effectively. These tests measure health related factors and a very narrow set of physical skills not directly tied to the METs. Second, the current test does a poor job of identifying the ground combatants that will have problems with the soldier's load and the extreme environmental conditions of the battlefield. Third, as terrible as it might sound, many individuals only do physical training for the annual assessment. In fact, many individuals do minimal physical training yearlong until just before the test and then they ramp up their training just prior to the evaluation to ensure that they pass. Obviously, this is problematic for several reasons. Not only does the individual lacks the Combat Physical Readiness required to perform the METs the other 10 months out of the year, but the likelihood of injury during the ramp up period is significantly higher, than if the individual was regularly conducting physical training throughout the year. Finally, this process reduces the intended health-related benefits that the assessment and training were designed to ensure.

The main intent of this type of an assessment is to ensure that all ground combatants are physically capable to operate and survive in the combat environment. It should provide quantifiable results that assess the overall combat fitness as well as the individual component in an effort to provide usable results so that the ground combatant

fully understands his or her strengths and weaknesses. Given that a portion of the military population only trains for the test, the secondary intent is to ensure that the ground combatants are at a minimum training level in these elements in preparation for the annual assessments. This certainly this is not the best case; however, it is reality in the military today, and while there is not any research that quantifies the benefits, undoubtedly training these elements will extend longevity and enhance performance. Therefore, based on current practices reference the annual fitness assessments, developing and implementing a combat fitness test is an imperative.

Based on the lack of research and the time required to synthesize the Joint combat fitness requirements, it is recommended that the OSD develop an interim solution that could be used to establish better understanding of the combat fitness requirements and provide a start point for the Services to meet minimum joint standards for their combat fitness programs. This action will ensure that the Services are required to develop fitness programs that will extend operator longevity and enhance combat effectiveness. There are several combat fitness assessments that are currently in use and have potential as an interim solution. The Rangers have developed an assessment, provided in Appendix C, which is a good starting point. Alternatively, the Marine Combat Fitness Test has been in use for more than year and the testing data could be leveraged to develop a joint solution. Until solid research is complete the best interim solution that would provide the comprehensive results desired, is a mix of these tests. Most importantly, the DoD must take action to get the Services headed in the right direction and that means requiring the ground combatants across the DoD to pass an annual combat fitness assessment. This is a significant step in preserving and enhancing the human weapons system.

Chapter Summary

In summary, this chapter tied the concepts presented in this paper together in a logical combat fitness training plan. The concepts presented all have merit; however, the difficulty is blending them all together into an effective yet manageable system that will serve as the basis for all ground combatant fitness training across the DoD. The first part of this chapter presented a plan that included the combat fitness concepts with little or no impact to the average physical training. Finally, an argument was presented in support of a new annual combat fitness evaluation that would supplement the current health-based evaluation. These recommendations play a key role in the development, implementation, and sustainment of a new doctrinally guided combat fitness program. Without these additional requirements, the long-term viability of this program will be in question. Thus, if the effort is made to preserve the most vital weapon system in the DoD then these additional recommendations should be accepted, adopted, and implemented.

CONCLUSION

This research paper looked at the Service level physical fitness programs across the DoD to determine if the fitness training currently being conducted is sufficient to train and sustain the ground combatant throughout their military careers. The deleterious effects that continued combat operations are having on the military today are considerable. Injury rates are but just one of those issues confronting the military. Based on today's constrained environment of tight budgets, reduced manpower, and rising healthcare costs, it is imperative that the DoD take the appropriate actions to deal with the musculoskeletal injury rates, the associated costs, and their effect on the DoD's operational capabilities.

Current combat operations in Iraq, Afghanistan, and around the globe are placing an incredible strain on the military. These operations have highlighted the weaknesses in the human weapons system. Based on the health and fitness of the youth in America, it appears that there will be little change in the physical ability of the future enlistees. And while technology will bring some weight reduction to the soldier's load, it will not significantly reduce the physical strain placed on the ground combatant in the hostile environment. Nor will it alter the risk aversion that America has become so accustomed to while conducting combat operations. Thus, America will continue to expect fewer casualties in combat and the result will be a continued demand for individual protection and capability, which in turn will drive up the weight and bulk of the soldier's load. Sustained combat operations and the preparation for combat have highlighted an increased injury rate across the DoD. Unfortunately, without changes to the DoD

physical fitness program, these two issues will continue to cause injury problems for the foreseeable future.

The rising DoD musculoskeletal injury rate is significant enough to demand answers about why that number is so high and what is being done to mitigate this problem. When the fiscal costs and the lost operational capability are factored into the equation, the problem becomes much more critical to the DoD. A quick recap of the injury facts presented earlier show that the estimated cost for the 743,547 musculoskeletal injuries in 2006 would exceed $2.2 billion.[1] Additionally, it was estimated that acute and overuse/chronic injuries together resulted in over 25,000,000 days of limited duty in 2005.[2] Finally, the conservative long-term medical costs associated with veteran care, treatment, and disability range anywhere from $350 to $660 billion dollars.[3] This data illustrates the seriousness of the injury problem and it is reasonable to expect that the senior leadership in the DoD and the Services should be actively seeking mitigation strategies to these issues plaguing the force.

Current Service fitness programs have been given broad execution authority in their physical fitness and testing programs. As one would expect, each of the Services has their own distinct view on what needs to be done and how it needs to be executed.

---

[1] Author extrapolated data derived from the following sources: Armed Forces Health Surveillance Center Silver Spring MD, *Medical Surveillance Monthly Report. Volume 16, Number 4, April 2009*, 10: U.S. Army Center for Health Promotion and Preventative Medicine, "Physical Training and Sports Injury Prevention Guidelines: Cost of Injury," 4.

[2] Army Center for Health Promotion and Preventive Medicine Aberdeen Proving Ground MD, "Preventing Injuries in the U.S. Military: The Process, Priorities, and Epidemiologic Evidence," 1-2.

[3] Butler, 16.

Unfortunately, when it comes to the development and execution of a combat fitness program, each Service is hindered by their Service unique mission, personalities of leaders and fitness professionals, and the historical development of the service program. Clearly, each service has its bright spots. In the end, the challenge is leveraging the best practices and lessons learned from each Service in an effort to raise the overall level in the DoD. Regrettably, without a synchronizing element such as the Joint Staff and overarching guidance and doctrine, it is likely that each service will continue to execute programs that are only marginally successful. This fact can be seen in the high injury rates and lost duty days the DoD is suffering through. Physical training is not only the leading cause of musculoskeletal injuries, it also contributes to combat training injuries and deployed injuries. These last two are specifically based on the lack of task-specific physical preparedness that the current fitness programs are providing. Training for these specific mission requirements has been delegated from the DoD to the Services and from the Services down to the individual units. Sadly, units lack the technical expertise to develop a program that both addresses the mission essential needs and mitigates the injuries currently being experienced during physical training. Based on this fact and the need for a synchronizing element, the DoD must provide specific guidance and doctrine to improve the fitness programs, decrease injuries, extend operational longevity and increase combat effectiveness.

In an effort to decrease injuries and maximize operational capability it is imperative that the DoD develop strategies to enhanced operator longevity. This paper presented seven strategies that if adopted could significantly increase operational longevity. Moreover, many of these strategies work together to create a synergistic effect

thus increasing the value and potential gains. The first strategy discussed was education. Education is a vital overarching concept that aimed at all personnel at all levels. Further, it is meant to be reoccurring in an effort to reinforce and provide opportunities to teach and learn new TTP. Without a solid education program associated with the combat fitness program there will be a lack of individual understanding, which will translate into lack of motivation, poor training programs developed and executed at the unit level, and finally, poor doctrine and guidance provided by senior leadership. The next four concepts are interrelated. Functional Movement Screening; Multiaxial, Neuromuscular, Proprioceptive, and Agility; Functional Warm-up; and Prehab versus Rehab are the four concepts that provide the foundation for the combat fitness program. The primary thrust of these concepts is to ensure the ground combatant can move effectively and efficiently in all planes of movement under the strain of the soldier's load and the stress of the combat environment. These concepts provide a pre-training assessment to determine weaknesses or asymmetries, a more comprehensive and effective warm-up, the skills to train the ground combatant to move correctly in all planes of movement, and specifically focus on injury prevention through prehab versus rehab.

The next concept offered to extend operator longevity was prevention of overtraining. This may seem obvious; however historical perspective tells us that the Services have not been very good at applying this concept. Specifically, the Services have excessively trained their members in running and this has led to significant injuries. Information provided showed that the Services could reduce running, which would reduce injuries, without much degradation in the aerobic capacity of the service members. It is important to note that his concept not only applies to running, it also applies to each

type of physical training as well as the overall program at large. Finally, a discussion on nutrition provided key facts that demonstrated the value of nutrition in injury prevention. Therefore, all of these concepts can directly affect the operational longevity of the ground combatant.

With a better understanding of the worth of these concepts, the DoD must weigh the costs and institutional challenges required to change the DoD's fitness paradigm against the fiscal and operational costs associated with current fitness practices. The dilemma the DoD must deal with is how many injuries is too many? What is the "tipping point" before the DoD makes the logical changes? Continual combat operations since September 11, 2001, have brought these issues to the forefront because of the operational impact they are having. Arguably, if the nation was not at war these injuries might not be as prevalent and thus not on the radar screen, as they would have been in the "acceptable" category. However, these issues are related to lifetime fitness and the long-term health and vitality of every military member. The fiscal costs are not experienced by the operational force as they are paid through the medical budget and the operational losses are usually passed on from commander to commander, and not fully realized by any one responsible person. Furthermore, the retired disability and medical costs are further removed from the operational commander thus distancing the immediate importance of training correctly. Therefore, despite these challenges, the decision to include this type of training to extend operational longevity is not only the fiscally responsible thing to do, it is a moral imperative.

Continual improvement is an important aspect of how the DoD conducts business. This applies to virtually everything the DoD does, to include weapons system

improvements. Just as the DoD makes programs for improvements in their planes, tanks, and ships it needs plans to develop a better more combat capable human. The section on enhanced combat effectiveness presented two concepts to improve the combat capability of the ground combatant. The first capability was situational awareness and this concept focused on vision and reaction training to improve situational awareness. This capability can improve the warrior's understanding and awareness on the modern battlefield dramatically. The benefits of this concept are linked to more than just the visual systems; they are connected to the visual sensing required in the neuromuscular training presented earlier. Therefore, this concept can improve movement, balance, and agility as well as situational awareness. The next concept discussed to improve effectiveness was cognitive ability. This concept unquestionably has potential to increase the combat effectiveness of every ground combatant. This training has the potential to provide the ability to execute complex motor tasks and/or make sound decisions in a stressed state. These are skills that would absolutely increase battlefield competence. Therefore, as the DoD conducts its planning, programming, and budgeting, it is imperative that it treat the human as a weapon system and develop a plan for systematic trainable improvements. Undeniably, these concepts are trainable and based on the modern battlefield complexity, the shrinking budget, reduced manpower and increase global demands the DoD must attempt to maximize the capability it fields in pursuit of the national interests.

Once again, these concepts beg the question: how much are these improvements worth to the DoD? What changes and costs will be required to institute this additional training? What training does not get done in lieu of this? The changes are similar to a new radar system being placed in an airplane or a sensor on a tank. These improvements

cost man-hours in training, initial modification, and maintenance just like the increased situational awareness and cognitive capability. This is a paradigm shift and will take significant effort by the DoD to include the Human Weapons System into their PPBE cycle, doctrine and guidance. The increased battlefield competence gained through training in these two new concepts will be considerable. As the future force shrinks and the military is asked, "to do more with less" skills like these will be critical to continued U.S. battlefield dominance.

Besides the seven concepts for extended longevity and the two concepts for enhanced effectiveness, this paper made four additional recommendations. Without implementation of these recommendations, the new combat fitness concepts will either be ineffective or less effective. The first recommendation was aimed at leadership. As with every endeavor in the military, the changes in the fitness programs have to start with the leaders. They need to not only support it, they need to be knowledgeable about it, understand the value, and most of all they need to lead by example and practice the new concepts. Also identified was need for detailed OSD guidance. Finally, in an effort to optimize human performance there needs to be a synchronizing element. This effort should establish effective communication and coordination across the Services in an effort to leverage best practices, lessons learned and research data across the medical, research and operational communities. The next recommendation is to establish a warrior culture in each service where combat fitness is an essential element in the service. This means that combat fitness is part of all training, schools, and evaluations. There should be recognition for high standards of combat fitness in schools and on performance reports. The Services must understand the long-term fiscal and operational benefits of a

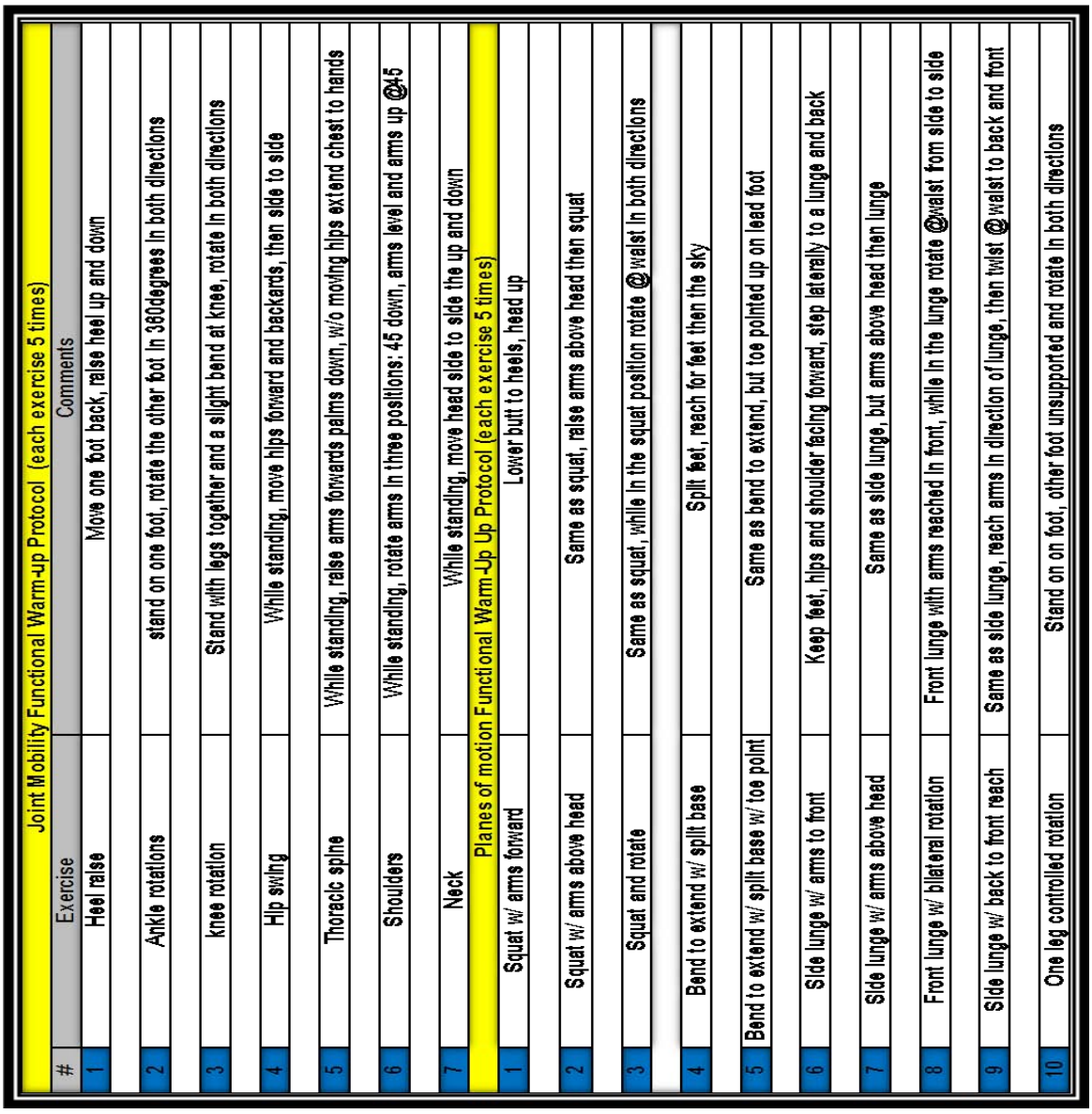
force that is combat fit. The final two recommendations provide a concept to conduct and evaluate the combat fitness concepts. It is important to understand that these concepts should be tied together in a logical manner in an effort to maximize the benefits. Additionally, the test and evaluation of the concepts is a critical component if the effort is take hold and grow roots into the service culture. The fact that numerous military personnel only train for the annual or semi-annual physical fitness test suggests that if combat fitness skills are desired then a test must be developed and adopted by the services. However, that is not the only reason for a combat fitness test, the real reason that a test should be developed and implemented is to provide a clear and accurate assessment of the ground combatant's ability to perform the assigned skills. These recommendations provide vital additional elements to solidify a combat fitness program that will both extend operational longevity and enhance combat effectiveness. Therefore, in addition to the seven concepts for extended longevity and two for enhanced effectiveness, these four recommendations must be adopted and implemented in a coherent combat fitness program across the Services for all ground combatants.

Based on future projections it is imperative that the DoD look to maximize every dollar spent. Current budget expenditures highlight that personnel and medical costs are the largest portion of the DoD budget. Based on these two facts, DoD leadership must seek to exploit every opportunity of fiscal responsibility. Mitigation of musculoskeletal injuries provides some immediate beneficial savings to the current year budget expenditures. The real benefit comes from the long-term savings gained through mitigation of long-term injuries that follow individuals through their career and potentially into retirement, where the Veteran's Administration becomes responsible for

both disability and continuing medical costs. In summary, this is why the DoD must embrace and incorporate modern physical fitness training systems, techniques, technology, and testing to better train and prepare ground combatants for the rigors of combat, including improved battlefield effectiveness and prolonged individual operational longevity, while minimizing the rash of short- and long-term injuries currently plaguing the force.

APPENDICES

APPENDIX A: Joint Mobility Functional Warm-up Protocol[1]



Joint Mobility Functional Warm-up Protocol (each exercise 5 times)		
#	Exercise	Comments
1	Heel raise	Move one foot back, raise heel up and down
2	Ankle rotations	stand on one foot, rotate the other foot in 360degrees in both directions
3	knee rotation	Stand with legs together and a slight bend at knee, rotate in both directions
4	Hip swing	While standing, move hips forward and backards, then side to side
5	Thoracic spine	While standing, raise arms forwards palms down, w/o moving hips extend chest to hands
6	Shoulders	While standing, rotate arms in three positions: 45 down, arms level and arms up @45
7	Neck	While standing, move head side to side the up and down
Planes of motion Functional Warm-Up Up Protocol (each exercise 5 times)		
1	Squat w/ arms forward	Lower butt to heels, head up
2	Squat w/ arms above head	Same as squat, raise arms above head then squat
3	Squat and rotate	Same as squat, while in the squat position rotate @waist in both directions
4	Bend to extend w/ split base	Split feet, reach for feet then the sky
5	Bend to extend w/ split base w/ toe point	Same as bend to extend, but toe pointed up on lead foot
6	Side lunge w/ arms to front	Keep feet, hips and shoulder facing forward, step laterally to a lunge and back
7	Side lunge w/ arms above head	Same as side lunge, but arms above head then lunge
8	Front lunge w/ bilateral rotation	Front lunge with arms reached in front, while in the lunge rotate @waist from side to side
9	Side lunge w/ back to front reach	Same as side lunge, reach arms in direction of lunge, then twist @waist to back and front
10	One leg controlled rotation	Stand on on foot, other foot unsupported and rotate in both directions

[1] Special Tactics Training Squadron. "Joint Mobility Functional Warm-up Protocol." Combat Athlete Program. 2009.

APPENDIX B: Functional Warm-up Protocol[1]

Functional Warm-Up Up Protocol

	Exercise	Comments	Distance 20 yards
1	Jog Forward	Head still, elbows in,arm drive	Up and Back
2	45 degree lunges	Pull knee up to chest with hands on up phase	Up
3	stiff leg toe tap	Quick touch and kick	Back
4	Jog Backwards	short front stride, long back stride	Up
6	High Knees	Knees above hips, hands go "hips-to-lips"	Back
5	Kereoka with Hip Flexion	Pop knee up and cross with each cycle	Up and Back
7	Lateral Slide/Swing Arms	Coordinated, rhythmical fashion	Up and Back
8	side lunges toe touch	Touch left and right toe with each stride	Up and Back
9	side slides(fast)	Hands out in a basketball defense position	Up
10	Butt kickers	Quick kicks up to butt	Back
11	Acceleration run	Gradually accelerate to full speed	Up and Back
Last	Leg swings on wall	Ballistic stretch shortening at the top	
		1) face wall,swing leg side to side	
		2) turn to side, swing leg forward and back	
		3) switch legs	

[1] Special Tactics Training Squadron. "Joint Mobility Functional Warm-up Protocol." Combat Athlete Program. 2009.

APPENDIX C: Ranger Athlete Warrior Assessment[1]

The primary purpose of the RAW assessments is to identify individual and team/squad areas needing improvement. This in turn guides subsequent physical training. The first nine tasks are athletic assessments that should be conducted twice during a complete training/deployment cycle. Tasks 1-7 are conducted in order during a single, 90-minute PT session. Tasks 8 and 9 require gym equipment and are conducted separate from Tasks 1-7, but within five calendar days of those tasks. The Ranger Physical Assessment Test (RPAT) is the primary tactical assessment and is conducted once per training/deployment cycle, separate from any athletic assessments by at least two days.

Field Expedient Assessments (for task/conditions/standards, see Appendix)

Task 1: Illinois Agility Test

Task 2: 4kg Backward Overhead Medicine Ball Throw (BOMB)

Task 3: Metronome Pushup

Task 4: Pull-ups

Task 5: 300-Yard Shuttle Run

Task 6: Heel Claps

Task 7: 20-Meter Shuttle Run

Gym-Based Assessments

Task 8: Deadlift with barbell at 225-lbs, max reps

---

[1] 75th Ranger Regiment Ranger Athlete Warrior Program. [Ft. Benning GA.: 75th Ranger Regiment], March 2009, 4-8.

Task 9: Bench Press with barbell at 185-lbs, max reps

Tactical Field Assessments

Task 10: Ranger Physical Assessment Test (RPAT). The purpose of this test is to measure all components of fitness (strength, endurance, and movement skills), using tactically relevant tasks.

1. Complete a 3-mile run and combat focused PT course in less than 1 hour. The event will be conducted at squad level, with the mindset that the Ranger is competing against himself. Each time the event is conducted, each Ranger should see constant improvement in his time and ability to negotiate the course.
2. Conduct a 2-mile run wearing ACUs, boots, RBA and MICH helmet. The run will begin and end at a 20-foot fast rope. After the completion of the run, immediately climb the 20-foot fast rope and do a controlled descent. When the rope climb is complete, drag a 160-pound SKEDCO litter 50 yards, turn round and drag it back 50 yards to the start point. Immediately following the SKEDCO pull, climb a 20-foot caving ladder and climb all the way back down. At the bottom of the Caving ladder, sprint 100 yards, turn around, sprint back 100 yards and climb over the 8-foot wall.
3. Conduct a 1 mile run wearing ACUs, boots, RBA and MICH helmet. The run will begin and end at the 8-ft wall. Time stops when you cross the line at the 8-foot wall.[2]

[2] Ibid.

BIBLIOGRAPHY

Primary Sources

Public Military Document

Baker-Fulco, Carol J., Beverly D. Patton, Scott J. Montain, and Harris R. Lieberman. *Nutrition for Health and Performance, 2001: Nutritional Guidance for Military Operations in Temperate and Extreme Environments*. Ft. Belvoir: Defense Technical Information Center, 2001.

Defense Market Research. "June 2003 Youth Poll 5: An Estimate of the Enlisted Supply." Washington DC: Defense Market Research Executive Notes. Executive Note No. 16, December 2003.

Department of Defense (1991) "Military Handbook Anthropometry of U.S. Military Personnel (Metric)." *Department Of Defense Handbook 743A (DOD-HDBK-743A).* February 13, 1991.

Department of Defense (1995) "Handbook for Human Engineering Design Guidelines." *Military Handbook 759C (MIL-HDBK-759C).* July 31, 1995.

Department of Defense (1999) "Design Criteria Standard: Human Engineering." *Military Standard 1472F (MIL-STD-1472F).* August 23, 1999.

Department of Defense. "Directive on Health Promotion and Disease/Injury Prevention." *DoD Number 1010.10.* Washington: Government Publishing Office, August, 2003.

Department of Defense. "DoD Physical Fitness and Body Fat Programs Procedures." *DoD Instruction 1308.3.* Washington: Government Publishing Office, November 2002.

Department of Defense. "DoD Physical Fitness and Body Fat Program." *DoD Directive 1308.1*. Washington: Government Publishing Office, June 2004.

Department of the Air Force. "Air Force Fitness Program." *AFI 10-248*. Washington: HQ USAF/SGO, July 2006.

Department of the Navy. "Navy Operational Fitness Series." Washington: Headquarters US Navy.

Department of the Navy. "Navy Operational Fueling." Washington: Headquarters US Navy.

Department of the Navy. "Physical Readiness Program." *OPNAVINST 6110.1H.* Washington: Headquarters U.S. Navy, 15 August 2005.

Department of the Navy. "Physical Readiness Program." *OPNAVINST 6110.1H CH-1*. Washington: Headquarters U.S. Navy, 19 May 2006.

Iverson, Christine, Lisa Upton, and Nikki Butler. *Building the Tactical Athlete: An Injury Prevention and Performance Enhancement Guide for Commanders and Leaders.* Fort Campbell, Blanchfield Army Community Hospital, June 2007.

U.S. Army Training and Doctrine Command. "An Imminent and Menacing Threat to National Security." *TRADOC Information Pamphlet.* Fort Monroe, VA, 2008.

U.S. Army Training and Doctrine Command. "Army Physical Readiness Training." *Training Circular 3-22.20.* Fort Monroe, VA, March 1, 2010.

U.S. Army. "Army Training and Leader Development." *Army Regulation 350-1*. HQ, Department of the Army, Washington, D.C., April 9, 2003.

U.S. Army. "Foot Marches." *Field Manual 21-18*. HQ, Department of the Army, Washington, D.C., June 1, 1990.

U.S. Army. "Physical Fitness Training." *Field Manual 21-20.* HQ, Department of the Army, Washington, D.C., 1998.

U.S. Army. "The Infantry Rifle Company." *Field Manual 7-10*. HQ, Department of the Army, Washington, D.C., October 31, 2000.

United States Marine Corps. "Marine Corps Body Composition and Military Appearance Program." *Order 6100.3.* Washington: Headquarters United States Marine Corps, August 8, 2008.

United States Marine Corps. "Marine Corps Physical Fitness Program." *Order 6100.13.* Washington: Headquarters United States Marine Corps, August 1, 2008.

United States Marine Corps. "Weight Control and Personal Appearance." *Order 6100.10B.* Washington: Headquarters United States Marine Corps, 1993.

United States Marine Corps. *Marine Physical Readiness Training for Combat*. [S.l.]: Wildside Press, 2005.

Government Reports and Hearings

Deuster, Patricia A. and Francis G. O'Connor. *Musculoskeletal Health and Injury Prevention.* Bethesda, MD: Uniformed Services University of the Health Sciences. Department of Military and Emergency Medicine Consortium for Health and Human Performance. July 1, 2008.

Deuster, Patricia A. *The Navy SEAL Physical Fitness Guide*. [Bethesda, Md.]: Dept. of Military and Emergency Medicine, Uniformed Services University of the Health Sciences, F. Edward Hebert School of Medicine, 1997.

Economos, Demetri. "Combat Load Report." Marine Corps Combat Development Command, Materiel Requirements Division, Quantico, VA, December 31, 2003.

Amos, James F., General, Assistant Commandant Marine Corps. Speaking On Soldier Equipment Ergonomics, on March 11, 2009, to the House Appropriations Committee Subcommittee on Defense, 111th Congress, 1st Session.

Chiarelli, Peter W., General, Vice Chief Of Staff United States Army. Speaking On Soldier Equipment Ergonomics, on March 11, 2009, to the House Appropriations Committee Subcommittee on Defense, 111th Congress, 1st Session.

RAW PT, V 3.0. [Ranger Athlete Warrior Physical Training] [Ft. Benning GA.: 75th Ranger Regiment, n.d.].

75th Ranger Regiment Ranger Athlete Warrior Program. [Ft. Benning GA.: 75th Ranger Regiment], March 2009.

Zaffram, Christopher and others. *Estimation of Marine Infantry Rifle Squad Load Weight.* Quantico VA, June 21-23 2005 [Presented at 73rd Military Operations Research Society Symposium, West Point, NY].

Interviews and Oral Histories

Abt, John, interview by Chris Larkin. Via telephone from Norfolk, VA. January 27, 2010.

Baumgartner, Neal, interview by Chris Larkin. Via telephone from Norfolk, VA. December 17, 2009.

Gambetta, Vern, interview by Chris Larkin. Via email from Norfolk, VA. January 12 to February March 21, 2010.

Levine, Jeremy, interview by Chris Larkin. Virginia Beach, VA. December 9, 2009.

Mercer, Glenn, interview by Chris Larkin. Via telephone from Norfolk, VA. January 11, 2010.

Palkoska, Frank, interview by Chris Larkin. Via telephone from Norfolk, VA. January 26, 2010.

Shaul, Rob, interview by Chris Larkin. Via email from Norfolk, VA. November 6 to January 9, 2010.

Strock, Michael, interview by Chris Larkin. Naval Amphibious Base Little Creek, VA. November 30, 2009.

Zupan, Michael, interview by Chris Larkin. Via telephone from Norfolk, VA. February 12, 2010.

Secondary Sources

Government Reports and Hearings

Armed Forces Health Surveillance Center Silver Spring MD. *Medical Surveillance Monthly Report. Volume 14, Number 1, April 2007*. Ft. Belvoir: Defense Technical Information Center, 2007.

Armed Forces Health Surveillance Center Silver Spring MD. *Medical Surveillance Monthly Report. Volume 15, Number 3, April 2008*. Ft. Belvoir: Defense Technical Information Center, 2009.

Armed Forces Health Surveillance Center Silver Spring MD. *Medical Surveillance Monthly Report. Volume 16, Number 4, April 2009*. Ft. Belvoir: Defense Technical Information Center, 2009.

Army Center for Health Promotion and Preventive Medicine Aberdeen Proving Ground MD. "Preventing Injuries in the U.S. Military: The Process, Priorities, and Epidemiologic Evidence." Ft. Belvoir: Defense Technical Information Center, 2008.

Bullock, Steven H., and Bruce H. Jones. *Recommendations for Prevention of Physical Training (PT)-Related Injuries: Results of a Systematic Evidence-Based Review by the Joint Services Physical Training Injury Prevention Work Group (JSPTIPWG)*. Ft. Belvoir: Defense Technical Information Center, 2003.

Butler, Nikki. "Injury as a Combat Multiplier." Master's Thesis, Carlisle Barracks, PA: U.S. Army War College, 2008.

Crowell, Harrison P. and others. "Cognitive and Physiological Performance of Soldiers While Carrying Loads over Various Terrains." Army Research Laboratory, Report No. ARL-TR-1779, May 1999.

Destadio, Frank. "Peacetime Physical Fitness and Its Effect on Combat Readiness: An Air Force Perspective." Master's Thesis, Carlisle Barracks, PA: U.S. Army War College, 1991.

Ezell, William L. "Battlefield Mobility and the Soldier's Load." Master's Thesis, Quantico, VA. CSC, 1992.

Garcia, J. *Integrating Advanced Physical Training Programs into the Marine Corps*. Ft. Belvoir: Defense Technical Information Center, 2009.

Harman, Everett and others. *Effects of a Specifically Designed Physical Conditioning Program on the Load Carriage and Lifting Performance of Female Soldiers*. Ft. Belvoir: Defense Technical Information Center, 1997.

Jones, Sarah B. and others. *Comparison of Physical Activity Among New United States Army Recruits and High School Students*. Fort Belvoir, VA: Defense Technical Information Center, 2006.

Knapik, J. J. and others. *A Review of the Literature on Attrition from the Military Services: Risk Factors for Attrition and Strategies to Reduce Attrition*. Ft. Belvoir: Defense Technical Information Center, 2004.

Knapik, J. J. and others. *Administrative and Safety Evaluation of the Proposed Army Physical Readiness Test (2002).* Aberdeen Proving Ground, MD: U.S. Army Center for Health Promotion and Preventive Medicine, June 2002.

Knapik, J. J. and others. *Evaluation of Two Army Fitness Programs: The TRADOC Standardized Physical Training Program for Basic Combat Training and the Fitness Assessment Program*. Ft. Belvoir: Defense Technical Information Center, 2004.

Knapik, J. J. and others. *Injuries and Physical Fitness Before and After Deployments of the 10th Mountain Division to Afghanistan and the 1st Cavalry Division to Iraq, September 2005 - October 2008*. Ft. Belvoir: Defense Technical Information Center, 2008.

Knapik, J. J. and others. *Injury Incidence and Injury Risk Factors Among U.S. Army Basic Trainees at Ft. Jackson SC, 1998 (Including Fitness Training Unit Personnel, Discharges, and Newstarts)*. Ft. Belvoir: Defense Technical Information Center, 1999.

Knapik, J. J. and others. *Injury Incidence, Injury Risk Factors, and Physical Fitness Of U.S. Army Basic Trainees At Ft. Jackson SC,1997.* U.S. Army Center For Health Promotion and Preventive Medicine, Epidemiological Consultation Report No. 29-HE- 7513 -98, 1998.

Knapik, J. J. and others. *Secular Trends in the Physical Fitness of American Youth, Young Adults and Army Recruits*. Ft. Belvoir: Defense Technical Information Center, 2004.

Knapik, J. J. and others. *The Case for Pre-Enlistment Physical Fitness Testing: Research and Recommendations*. Ft. Belvoir: Defense Technical Information Center, 2004.

Knapik, J. J. and others. *The Victory Fitness Program: Influence Of The US Army's Emerging Physical Readiness Training Doctrine On Fitness And Injuries In Basic Combat Training.* Aberdeen Proving Ground, MD., and Fort Benning, GA., U.S. Army Center for Health Promotion and Preventive Medicine and U.S. Army Physical Fitness School, (2001).

Knapik, J. J. *Loads Carried by Soldiers: Historical, Physiological, Biomechanical and Medical Aspects*. Ft. Belvoir: Defense Technical Information Center, 1989.

Knapik, J. J., and Katy Reynolds. *Load Carriage in Military Operations: A Review of Historical, Physiological, Biomechanical, and Medical Aspects*. Ft. Belvoir: Defense Technical Information Center, 1997.

O'Donnell, Frederick M. *Physical Training Programs In Light Infantry Units: Are They Preparing Soldiers For The Rigors Of Combat?* Master's Thesis. Fort Leavenworth, KS: U.S. Army Command and General Staff College, 2001.

Obesity: Halting the Epidemic by Making Health Easier. Atlanta, GA: U.S. Dept. Of Health and Human Services, Centers For Disease Control & Prevention, National Center For Chronic Disease Prevention And Health Promotion, 2009.

Pemrick, Michael D. *Physical Fitness and the 75th Ranger Regiment: the Components of Physical Fitness and the Ranger Mission*. Master's Thesis. Fort Leavenworth, KS: U.S. Army Command and General Staff College, 1999.

Perkins, Karen M. *Civilian Fitness: A Readiness Enabler*. U.S. Army War College Strategy Research Project. Carlisle Barracks, PA: U.S. Army War College, 2008.

Pleban, R. J., D. A. Thomas, and H. L. Thompson. *Physical Fitness as a Moderator of Cognitive Work Capacity and Fatigue Onset under Sustained Combat-Like Operations*. Technical Report Aug 1982-Mar 1983, Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA, June 1985.

Polcyn, Amy F. and others. *Effects of Weight Carried by Soldiers: Combined Analysis of Four Studies on Maximal Performance, Physiology, and Biomechanics*. Ft. Belvoir: Defense Technical Information Center, 2002.

Rudzki, S. J. and M. J. Cunningham. *The Effect Of A Modified Physical Training Program In Reducing Injury And Medical Discharge Rates In Australian Army Recruits.* Canberra Area Medical Unit, Duntroon, Australian Capital Territory, Australia. 1996.

Ruscio, Bruce and others. *DoD Military Injury Prevention Priorities Working Group: Leading Injuries, Causes, and Mitigation Recommendations*. Fort Belvoir, VA: Defense Technical Information Center, 2006.

Santee, W.R. and others. "Load Carriage Model Development and Testing With Field Data." *USARIEM Tech Note TN03-3*. Biophysics and Biomedical Modeling Division; US Army Research Institute of Environmental Medicine, Natick, MA, 2003.

Swiderski, Steven J. *Fit-To-Fight: Waist Versus Waist/Height Measurements To Determine An Individual's Fitness Level – A Study In Statistical Regression And Analysis*. Master's Thesis. School of Engineering and Management, Air Force Institute Of Technology (AU), Wright-Patterson Air Force Base, OH, June 2005.

Townsend, Stephen J. *The Factors of Soldier's Load.* Master's Thesis. U.S. Army Command and General Staff College, Fort Leavenworth, KS, 1994.

U.S. National Center for Chronic Disease Prevention and Health Promotion. *Preventing Obesity and Chronic Diseases through Good Nutrition and Physical Activity*. Atlanta, GA: Centers For Disease Control & Prevention, National Center for Chronic Disease Prevention and Health Promotion, U.S. Department of Health and Human Services, 2005.

U.S. National Center for Chronic Disease Prevention and Health Promotion. *Physical Activity and Health: A Report Of the Surgeon General: Executive Summary*. Atlanta, GA: Centers for Disease Control & Prevention, National Center For Chronic Disease Prevention And Health Promotion, U.S. Department of Health and Human Services, 1996.

Walkawicz, Jennifer S. *Tapping into the US Cultural Shift: Revising Enlistment Standards Today To Avoid Conscription Tomorrow.* Master's Thesis. Joint Forces Staff College, Norfolk, VA, 2009.

Welsh, T.T., and others. *Monitoring Warfighter's Physical Performance during Sustained Operations Using a Field Expedient Jumping Test*. Ft. Belvoir: Defense Technical Information Center, 2004.

Worden, Thomas E. *A Comparison Of The US Air Force Fitness Test And Sister Service's Combat Oriented Fitness Tests.* Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio, 2009.

Reports

Boehmer, Matt and others. *Department of Defense June 2003 Youth Poll 5 Overview Report*. Ft. Belvoir: Defense Technical Information Center, 2003.

Bruggemann, Gert-Peter and others. "Effect of Increased Mechanical Stimuli on Foot Muscles Functional Capacity." *International Society of Biomechanics 20th Congress.* Cleveland, OH: July 31, 2006.

Bueke, Boris and Lutz Graumann. "Nike Free Running Study." *7th International Sports Engineering Association Conference*. Biarritz, FR: June 2, 2008.

Hollander, Ilyssa E., Nicole S. Bell, and Marilyn Sharp. *Physical Demands of Army Military Occupational Specialties: Constructing and Applying A Crosswalk To Evaluate The Relationship Between Occupational Physical Demands And Hospitalizations.* Ft. Belvoir: Defense Technical Information Center, 2008. Http://Handle.Dtic.Mil/100.2/ADA482364.

Katz, Shane, and others. "Static and Dynamic Warm-up in Upper Extremity Functional Activities." *Proceedings of the 5th Annual GRASP Symposium*, Wichita State University, 2009.

Nike Sensory Sport Training. "Visual Training Slides." Portland, OR, 2008. [Presentation provided to author by Nike]

Nike Sensory Sport Training. "Summary – Special Operations Sensory Training @ Nike." Portland, OR, 2010. [Paper provided to author by Nike]

Rideout, Victoria J., Ulla G. Foehr, and Donald F. Roberts. *Generation M2: Media in the Lives of 8- to 18-Year-Olds*. Menlo Park, CA: Henry J. Kaiser Family Foundation, 2010.

Sackett, Paul R. and Anne S. Mavor. *Assessing Fitness for Military Enlistment; Physical, Medical and Mental Health Standards.* Washington, DC. The National Academies Press, 2006.

U.S. Department of Health and Human Services and U.S. Department of Agriculture. "Dietary Guidelines for Americans, 6th Edition, 2005." Washington, DC: U.S. Government Printing Office.

U.S. Dept. of Health and Human Services. *Physical Activity Guidelines Advisory Committee Report, 2008 to the Secretary of Health and Human Services*. Washington, DC: U.S. Dept. of Health and Human Services, 2008.

U.S. National Center for Chronic Disease Prevention and Health Promotion, and President's Council on Physical Fitness and Sports. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta, GA: U.S. Dept. of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996.

Newspapers

Gregg, Zoroya. "Troop Obesity Doubles Since 2003." *USA Today*, February 9, 2009.

Heinrichs, Allison. "Pitt Strengthens Training for Army." *Pittsburgh Tribune Review*, August 31, 2009.

Kelly, Jack. “Mission Possible: Training to Prevent Injuries Gains Strength at an Army Base.” *Pittsburgh Post Gazette*, September 2, 2009.

Solgere, A. L. "A Soldier's Load . . . Revisited". *Marine Corps Gazette.* 83, no. 10: 35-36 October 1999.

Tilghman, Andrew. “CFT: Certainly ‘Freakin’ Tough.” *Marine Corps Times*, April 21, 2008.

Tyson, Ann Scott. “Weight Of Combat Gear Is Taking Toll; The Loads Are Contributing To Injuries That Are Keeping Some Troops On The Sidelines.” *Washington Post*, February 1, 2009.

Magazine Articles and Journals

Atwells, Renee, and others. “Influence of Carrying Heavy Loads on Soldiers' Posture, Movements and Gait.” *Ergonomics* 49, no. 14 (November 15, 2006): 1527-37.

Beekley M.D. and others. "Effects of Heavy Load Carriage During Constant-Speed, Simulated, Road Marching". *Military Medicine* 172, no. 6 (2007): 592-5.

Billings, Christine. “Epidemiology of Injuries and Illness during the United States Air Force Academy 2002 Basic Cadet Training Program: Documenting the Need for Prevention.” *Military Medicine* 169, no. 8 (August 2004): 664-70.

Birrel, Stewart, and others. “The Effect of Military Load Carriage on Ground Reaction Forces.” *Gait and Posture* (2007): 611-14.

Birrel, Stewart, and Roger Haslam. “Subjective Skeletal Discomfort Measured Using A Comfort Questionnaire Following A Load Carriage Exercise.” *Military Medicine* (February 2009): 177-82.

Blackburn, Troy, and Darin Padua. “Sagittal-Plane Trunk Position, Landing Forces, and Quadriceps Electromyographic Activity.” *Journal of Athletic Training* 44, no. 2 (March 2009): 174-79.

Bonacci J, A. Chapman, P. Blanch, and B. Vicenzino. "Neuromuscular Adaptations to Training, Injury and Passive Interventions: Implications for Running Economy." *Sports Medicine (Auckland, N.Z.)* 39, no. 11 (2009): 903-21.

Brundage, John, and others. “Comparing the Population Health Impacts of Medical Conditions Using Routinely Collected Health Care Utilization Data: Nature and Sources of Variability.” *Military Medicine* 171, no. 10 (October 2006): 937-42.

Brushoj, Christoffer and others. “Prevention Of Overuse Injuries By A Concurrent Exercise Program In Subjects Exposed To An Increase In Training Load.” *American Journal of Sports Medicine* 36, no. 4 (April 2008): 663-70.

Chappell J.D. and O. Limpisvasti. "Effect of a Neuromuscular Training Program on the Kinetics and Kinematics of Jumping Tasks." *The American Journal of Sports Medicine* 36, no. 6 (2008): 1081-6.

Dean, Charles. "Study Says Load Too Heavy." *Infantry* 93, No. 2 (March 2004): 5.

Deschenes M.R. and others. "The Efficacy of Prehabilitative Conditioning: Ameliorating Unloading-Induced Declines in the Muscle Function of Humans." *American Journal of Physical Medicine & Rehabilitation / Association of Academic Physiatrists* 88, no. 2 (2009).: 136-44.

Deuster, Patricia, and others. "Human Performance Optimization: An Evolving Charge to the Department Of Defense." *Military Medicine* 172, no. 11 (November 2007): 1133-1137.

Fitzgerald, G. K. and others. 2002. "Agility and Perturbation Training for a Physically Active Individual with Knee Osteoarthritis". *Physical Therapy* 82:372-382.

Gil, Cristina. "New Standards: Fitness And Appearance Programs Revised." *Marines* (April 2008): 38-9.

Goodall, R. "Injury Prevention: Physical Training in the Australian Army." *Australian Defence Force Journal* 165 (2004): 49-63.

Hogan, Joyce. "Structure of Physical Performance in Occupational Tasks." *Journal of Applied Psychology* 76, No. 4 (August 1991): 495-507.

Hrysomallis, C. "Relationship between Balance Ability, Training and Sports Injury Risk". *Sports Medicine (Auckland, N.Z.)* 37, no. 6 (2007): 547-56.

Jones, B.H. and Knapik J.J. "Physical Training and Exercise-Related Injuries. Surveillance, Research and Injury Prevention in Military Populations." *Sports Medicine* 27 (1999): 111-25.

Jones, Bruce H. and others. "Articles - Part I - Injuries in the Military: A Review and Commentary Focused On Prevention". *American Journal of Preventive Medicine* 18, No. 3 (2000): 71.

Kiesel, K., P.J. Plisky, and M.L. Voight. "Can Serious Injury In Professional Football Be Predicted By A Preseason Functional Movement Screen?" *North American Journal of Sports Physical Therapy* 2, No. 3 (2007): 147-55.

Knapik J.J. and others. "Injuries Associated With Strenuous Road Marching." *Military Medicine* 157(2) (February 1992):64-7.

Knapik J.J. and others. "Physical Fitness, Age, and Injury Incidence in Infantry Soldiers." *Journal of Occupational Medicine* 35, No. 6 (June 1993): 598-603.

Knapik, J. J. and others. “Evaluation of a Standardized Physical Training Program for Basic Combat Training.” *The Journal of Strength and Conditioning Research* Vol. 19, Issue 2 (May 2005): 246-53.

Knapik, J. J. and others. **“**Injury and Fitness Outcomes during Implementation of Physical Readiness Training”**.** *International Journal of Sports Medicine* 195 Vol. 24, Issue 5 (2003): 372-81.

Knapik, J. J., and others. "Temporal Changes In The Physical Fitness Of US Army Recruits." *Sports Medicine* 36, No. 7 (May 2006): 613-634.

Knapik, J. J., and others. "United States Army Physical Readiness Training: Rationale and Evaluation of the Physical Training Doctrine." *Journal of Strength & Conditioning Research* 23, No. 4 (July 2009): 1353-362.

Knapik, J. J., Katy L. Reynolds, and Everett Harman. "Soldier Load Carriage: Historical, Physiological, Biomechanical and Medical Aspects." *Military Medicine* 169, No. 1 (January 2004): 45-56.

Lephart, S.M. and others. “The Role of Proprioception in the Management and Rehabilitation of Athletic Injuries.” *American Journal of Sports Medicine* 25 (1) (1997): 130-137.

Lephart, S.M., D.M. Pincivero, and S.L. Rozzi. "Proprioception of the Ankle and Knee." *Sports Medicine* 25, No. 3 (March 1998): 149-55.

Liu-Ambrose, Khan, Eng, Lord, and McKay. 2004. "Balance Confidence Improves with Resistance or Agility Training". *Gerontology* 50, no. 6 (2004): 373-382.

Mahoney, Caroline R. and others. “The Effects of Movement and Physical Exertion on Soldier Vigilance.” *Aviation, Space, and Environmental Medicine* 78 (May 2007): B 51.

May, Bryson, Phillip D. Tomporowski, and Michael Ferrara. "Effects of Backpack Load on Balance and Decisional Processes." *Military Medicine* 174, No. 12 (December 2009): 1308-312.

Mcguire, Brian. "Mobility: A Forgotten Component of Marine Corps PT." *Marine Corps Gazette* 85, No. 2 (February 2001): 21.

Mcguire, Brian. A Close-Up of the Combat Fitness Test. *Marines* (July, August, September 2008): 34.

Mchale, John. "Exoskeleton Technology Reduces Soldier Fatigue And Injury." *Military & Aerospace Electronics* 20, No. 6 (June 2009): 6-12.

McLellan, Tom M., and others. “The Impact of Caffeine on Cognitive and Physical Performance and Marksmanship during Sustained Operations.” *Canadian Military Journal*, winter 2003-2004: 47-54.

Miller, Michael G. and others. “The Effects of a 6-Week Plyometric Training Program on Agility.” *Journal of Sports Science and Medicine*, 5, (2006): 459-65.

Myer, Gregory D., and others. "The Effects of Plyometrics versus Dynamic Stabilization and Balance Training On Lower Extremity Biomechanics." *American Journal of Sports Medicine* 34, No. 3 (March 2006): 445-55.

Myer, Gregory D., Kevin R. Ford, Joseph P. Palumbo, and Timothy E. Hewett. "Neuromuscular Training Improves Performance and Lower-Extremity Biomechanics in Female Athletes". *The Journal of Strength and Conditioning Research* 19, no. 1 (2005): 51-60.

Nigg, Benno. “Biomechanical Considerations on Barefoot Movement and Barefoot Shoe Concepts.” *Footwear Science* 1 no. 2 (June 2009):73-9.

Parco M., Siu. "Effect of Frequency of Carbohydrate Feedings on Recovery and Subsequent Endurance Run." *Medicine & Science in Sports & Exercise* 36, no. 2 (February 2004): 315-323.

Paterno, M.V., G.D. Myer, K.R. Ford, and T.E. Hewett. "Neuromuscular Training Improves Single-Limb Stability in Young Female Athletes". *The Journal of Orthopaedic and Sports Physical Therapy* 34, no. 6 (2004): 305-16.

Patton, John F. and others. “Effects of Continuous Military Operations on Physical Fitness Capacity and Physical Performance.*” Work & Stress* Volume 3, Issue 1 (January 1989): 69-77.

Peate W.F. and others. "Core Strength: a New Model for Injury Prediction and Prevention". *Journal of Occupational Medicine and Toxicology (London, England)* 2 (2007).

“Physical Activity in the Australian Defence Force.” *Journal of Science and Medicine Sport*, 7 (1) (2004):106-17.

Pronk, N. P. and others. “The Association between Work Performance and Physical Activity, Cardiorespiratory Fitness, and Obesity.” *Journal of Occupational and Environmental Medicine* 46(1) (January 2004): 19-25.

Risberg M. A. and others. "Design and Implementation of a Neuromuscular Training Program Following Anterior Cruciate Ligament Reconstruction". *The Journal of Orthopaedic and Sports Physical Therapy.* 31, no. 11 (2001): 620-31.

Robinette, Zoe. "Training the Industrial Athlete: Fitness Training At UPS." *Occupational Health & Safety* 76, No. 4 (April 2007): 34-38.

Ryan M., McDonald K., J. Taunton, and S. Fraser. "Examining the Degree of Pain Reduction Using a Multielement Exercise Model with a Conventional Training Shoe Versus an Ultraflexible Training Shoe for Treating Plantar Fasciitis". *Physician and Sportsmedicine.* 37, no. 4 (2009): 68-74.

Santtila M., H. Kyrolainen, and K. Hakkinen. "Changes in Maximal and Explosive Strength, Electromyography, and Muscle Thickness of Lower and Upper Extremities Induced by Combined Strength and Endurance Training in Soldiers". *Journal of Strength and Conditioning Research* 23, no. 4 (2009): 1300-1308.

Sawka, Michael and others. "Exercise and Fluid Replacement". *Medicine and Science in Sports and Exercise.* 39, no. 2 (2007): 377-90.

Sherrard, Jenny. *Strategic Direction and Advice for Increasing Safe Participation in Physical Activity in the Australian Defence Force A Report for the Defence Health Service*. Clayton, Vic: Monash University Accident Research Centre, 2002.

Taylor, Marcus K., and others. "Physical Fitness Influences Stress Reactions to Extreme Military Training." *Military Medicine* 173, No. 8 (August 2008): 738-742.

U.S. Centers for Disease Control, National Center for Chronic Disease Prevention and Health Promotion. "Physical Activity and Good Nutrition: Essential Elements To Prevent Chronic Diseases and Obesity 2003." *Nutrition in Clinical Care: An Official Publication of Tufts University* 6, No. 3 (2003).

Wagner, T. and others. "Strengthening and Neuromuscular Reeducation of the Gluteus Maximus in a Triathlete with Exercise-Associated Cramping of the Hamstrings". *Journal of Orthopaedic and Sports Physical Therapy* 40, no. 2 (2010): 112-119.

Williams, A. G., and M. P. Rayson. "Can Simple Anthropometric and Physical Performance Tests Track Training-Induced Changes in Load-Carriage Ability?" *Military Medicine* 171, no. 8 (2006): 742-748.

Williams, Alun G. and others. “Training Diagnosis for a Load Carriage Task.” *Journal of Strength and Conditioning Research* (2004): 30-34.

Yamane, Grover K. "Obesity in Civilian Adults: Potential Impact on Eligibility for U.S. Military Enlistment." *Military Medicine* 172, No. 11 (November 2007): 1160-1165.

Yoo, Jae Ho and others. “A meta-analysis of the effect of neuromuscular training on the prevention of the anterior cruciate ligament injury in female athletes.” *Knee Surgery, Sports Traumatology, Arthroscopy* (4 September 2009).

Zupan, Michael F. and others. "Visual adaptations to sports vision enhancement training: A study of collegiate athletes at the US Air Force Academy." *Optometry Today* (19 May, 2006): 43-8.

Books

Gambetta, Vern. *Athletic Development: The Art and Science of Functional Sports Conditioning*. Champaign, IL: Human Kinetics, 2007.

Gambetta, Vern. *Gambetta Method: A Common Sense Guide to Functional Training for Athletic Performance*. Sarasota, FL: Gambetta Sports Training Systems, Inc., 2002.

Giles, Kevin B. *Movement Dynamics Athlete Development: Physical Competence Assessment Manual*. UK: Movement Dynamics, 2009.

Grossman, Dave. *Killing; The Psychological Cost Of Learning To Kill In War And Society*. Boston: Little Brown and Company, 1995.

Marshall, S.L.A., Brigadier General. *The Soldier's Load and the Mobility of a Nation*. Quantico, Virginia: Reprinted By the Marine Corps Association, 1980.

National Research Council (U.S.), Paul R. Sackett, And Anne S. Mavor. *Assessing Fitness for Military Enlistment Physical, Medical, and Mental Health Standards*. Washington, D.C.: National Academies Press, 2006.

Verstegen, Mark and Pete Williams. *Core Performance Endurance: A New Fitness and Nutrition Program that Revolutionizes the way you train for Endurance Sports*. New York: Rodale, 2007.

Welch, P.D. *History Of American Physical Education And Sport (2nd Ed.)*.Springfield, IL: Charles C. Thomas, 1996.

West, D.A., and Bucher, C.A. *Foundations of Physical Education and Sport*. St.Louis, MO: Mosby, 1995.

Online Sources

"About BMI for Adults." Centers for Disease Control and Prevention. Available from Http://Www.Cdc.Gov/Nccdphp/Dnpa/Healthyweight/Assessing/Bmi/Adult_BMI/About_Adult_BMI.Htm. (accessed January 25, 2010).

Athlete's Performance. "Methodology: A System Based Approach." http://www.athletesperformance.com/assets/sp-12.pdf (accessed January 2010).

Carden, Michael J. "Total Fitness Seeks Unit, Troop Effectiveness." *Armed Forces Press Service* (October 29, 2009). http://www.army.mil/-news/2009/10/30/29581-total-fitness-seeks-unit-troop-effectiveness/. (accessed January 7, 2010).

Centers for Disease Control and Prevention. "Data and Statistics." Centers for Disease Control and Prevention. Http://Www.Cdc.Gov/Scientific.Htm. (accessed February 27, 2010).

Centers for Disease Control and Prevention. "Overweight and Obesity." Centers for Disease Control and Prevention. http://www.cdc.gov/obesity/childhood/causes.html (accessed November 2009).

Cook, Gray. "Balanced Body Series." Functional Movement Systems. http://www.functionalmovement.com/SITE/publications/downloads/StaticStretching.pdf (accessed February 9, 2010).

Cook, Gray. "The Functional Movement Screen: The system for a simple and quantifiable method of evaluating basic movement abilities." Functional Movement Systems. http://www.functionalmovement.com/SITE/publications/downloads/FMSPB.pdf (accessed January 2010).

Glassman, Greg. "CrossFit Presentation at National War College." CrossFit Journal. Http://Journal.Crossfit.Com/2009/01/National-War-College-Speech-Part-1.Tpl (accessed September 9, 2009).

Jones, Ron. "Movement Preparation Exercises." Ron Jones High Performance Health. http://www.ronjones.org/Handouts/MovementPrep.pdf (accessed January 19, 2010).

Kitfield, James. "Successes: Generation Y Is Producing Good Soldiers," January 19, 2007. Http://Nationaljournal.Com/About/Njweekly/Stories/2007/Sotu/Sotu07.Htm (accessed December 2009).

Leadership Now. "Quotes on Change." Leading Thoughts: Building a Community of Leaders. http://www.leadershipnow.com/changequotes.html. (accessed March 2010).

Learning RX. "Which Cognitive Skills are Most Important for Success." Define Cognitive Thing. http://www.learningrx.com/define-cognitive-thinking-faq.htm. (accessed February 2010).

Powers, Rod. "Marine Corps Combat Fitness Test." U.S. Military About.com. Http://Usmilitary.About.Com/Od/Marines/A/Cft.Htm (accessed August 2009).

Shaul, Rob. “Range Fitness.” Military Athlete. http://www.militaryathlete.com. (accessed 4 February, 2010).

“ Sports Vision Training Takes Athletes to New Frontiers.” *Sports Vision Magazine*, June 14, 2007. http://www.sportsvisionmagazine.com. (accessed February 1, 2010).

U.S. Army Center for Health Promotion and Preventative Medicine. “Physical Training and Sports Injury Prevention Guidelines: Cost of Injury.” http://chppm-www.apgea.army.mil/ptipt/Docs/Formatted%20Combined%20Job%20Aides/Opening%20Statistics_final.pdf. (accessed January 12, 2010).

U.S. Army Center for Health Promotion and Preventative Medicine. “Physical Training and Sports Injury Prevention Guidelines: Perform Multiaxial, Neuromuscular, Proprioceptive, and Agility Training.” http://chppm-www.apgea.army.mil/ptipt/Docs/Formatted%20Fact%20Sheets%20Recommended%20Interventions/RECOMMENDED%20INTERVENTION%20MULTIAXIAL%20AND%20AGILITY_final.pdf. (accessed January 25, 2010).

U.S. Army Center for Health Promotion and Preventative Medicine. “Physical Training and Sports Injury Prevention Guidelines: Functional Movement Screen.” http://chppm-www.apgea.army.mil/ptipt/Docs/Formatted%20Combined%20Job%20Aides/injury%20screening_final.pdf. (accessed January 25, 2010).

U.S. Department of Health and Human Services. “Physical Activity Facts.” The President's Council on Physical Fitness and Sports. http://www.fitness.gov/resources_factsheet.htm. (accessed August 2009).

University of Pittsburgh, Neuromuscular Research Laboratory. “Department of Defense Injury Prevention and Performance Optimization Research.” *Department of Defense Research Projects* Fall 2008. http://www.pitt.edu/~neurolab/research/dod/NMRL_DOD%20Newsletter%20Fall08.pdf. (accessed January 17, 2010).

University of Pittsburgh, Neuromuscular Research Laboratory. “Department of Defense Injury Prevention and Performance Optimization Research.” *Department of Defense Research Projects* Spring 2009. http://www.pitt.edu/~neurolab/research/dod/NMRL_DOD%20Newsletter%20Spring09.pdf. (accessed January 17, 2010).

Webster, Tony. “How We Got Here: CrossFit Versus The Fitness Industry.” CrossFit Journal Articles. Http://Journal.Crossfit.Com/2009/08/How-We-Got-Here-Crossfit-Vs-The-Fitness-Industry.Tpl (Accessed September 9, 2009).

VITA

Major Christopher P. Larkin is currently enrolled in residence at the Joint Advanced Warfighting School (JAWS), Joint Forces Staff College, Norfolk, Virginia. JAWS educates selected O-4s, O-5s and O-6s, interagency civilians and selected international officers in the art and science of joint, interagency and multinational planning and warfighting at the strategic-operational level of war as directed by the CJCS Officer Professional Military Education Policy. JAWS awards Service Intermediate (Staff College) or Senior Level College (War College) credit (based on student rank and experience) as well as single phase Joint Professional Military Education (JPME I & II). JAWS graduates earn a fully accredited Masters of Science degree in Joint Campaign Planning and Strategy.

He entered the Air Force in October, 1983. After serving 12 years as an enlisted combat controller, followed by a short break in Service, he received his commission through the Air Force Reserve Officer Training Corps program at Southwest Texas State University—recognized as a distinguished honor graduate. His career has included assignments at the flight, squadron, group, and major command levels supporting combat, humanitarian, special operations, and unconventional warfare missions around the globe. He has led Special Tactics and combat control forces during Operations ENDURING FREEDOM and IRAQI FREEDOM and conducted missions during Operations JUST CAUSE and DESERT STORM.

Holds a Bachelor's degree in Exercise Sports Science and has completed the US Army Master Fitness Trainer's Course. Previously held certifications from the American College of Sports Medicine as an Exercise Leader and USA Triathlon as a Level I coach.

He has competed in a wide variety of individual sports ranging from NCAA Division I Cross Country to Ironman Triathlon; and as a member of the Air Force Downhill Ski team and the US Military Pentathlon Team.